
 Boring Log		LAMSON ENGINEERING CORPORATION 437 Cherry Street, #109, Newton, Massachusetts 02465 Phone: (617) 558-0101 E-Mail: Lamsoneng@msn.com				Boring No. BB-4		Page 1/1	
						Scale: 1" = 5'			
City/Town: Wilmington		Bridge No.: W-38-003 (2NV)		Project File No.: 608929		Contract No.: -			
Location: Butters Row over MBTA/PAN AM Railroad				Date & Time Started: 1/15/21 10:30 a.m.		Total Hours:			
Groundwater Depth (Feet): 14.0' Date & Time: 1/15/21 2:00 p.m.				Date & Time Completed: 1/15/21 2:30 p.m.		4			
Coordinates: N 3,021,592		E 746,560		Ground Elevation (Feet): 100.3'		Inspector's Name: Weijie Dong			
Drilling Company: New England Boring Contractors				Driller's Name: Mark D'Ambrosio		Helper's Name: Cody Richards			
Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches Coring Times Minute Per Foot				Recovery (inches)	Field Description		Strata Changes
S-1	2' - 4'	16	10	6	8	12"	Asphalt 3.5"		
							Dry, medium dense, black, FINE TO COARSE SAND AND FINE TO COARSE GRAVEL, trace inorganic silt.		
S-2	4' - 6'	40	20	18	20	12"	Dry, dense, brown, FINE TO COARSE SAND AND FINE TO COARSE GRAVEL, trace inorganic silt.		
S-3	10' - 12'	4	6	6	7	10"	Dry, medium dense, brown, FINE TO COARSE SAND, some fine gravel, trace inorganic silt.		
S-4	15' - 17'	13	24	33	35	15"	Wet, very dense, brown, FINE TO COARSE SAND AND FINE TO COARSE GRAVEL, trace inorganic silt.		
S-5	20' - 21'4"	27	20	100/4"	7"	Wet, very dense, brown, FINE TO COARSE SAND AND FINE TO COARSE GRAVEL, trace inorganic silt.		21'4"	
						Cobble 21'9"			
S-6	26' - 26'2"	120/2"			2"	Brown, Sand & Gravel from Wash.		24'6"	
						Boulder		26'	
						Wet, very dense, brown, FINE TO COARSE SAND AND FINE TO COARSE GRAVEL, trace inorganic silt. Possible Top of Bedrock @ 29'		29'	
						Rollerbit to 30'. Bottom of Exploration @ 30'		30'	
Notes:						Arrow-Board: - Signs: 4 Cones: 6		Protective Device Stand: - Box: - Well Depth: - Solid Pipe: - Stick Up Pipe: - Screen Pipe: -	
Penetration Resistance (N) Guide:							Type of Drill Rig: Truck - GT8		
Cohesionless Soils (Sands, Gravels)				Cohesive Soils (Silts, Clays)			Hammer Weight: 300 lbs Fall: 24"		
Relative Density		Penetration Resistance		Consistency		Penetration Resistance		Casing Types: HW NW	
Very Loose 0 - 4		Very Soft 0 - 2		Size: 4" 3"		Depth: 20' 26'		Sampler Type: S/S Size: 1 3/8" ID	
Loose 4 - 10		Soft 2 - 4		Automatic Hammer Weight:		Safety Hammer Weight: 140 lbs		Donut Hammer Weight: Fall: 30"	
Medium Dense 10 - 30		Medium Stiff 4 - 8							
Dense 30 - 50		Stiff 8 - 15							
Very Dense Over 50		Very Stiff 15 - 30							
N=Sum of Second and Third 6" Blow Counts		Hard Over 30							
Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less							Core Barrel Type: - Size: -		

 Boring Log		LAMSON ENGINEERING CORPORATION 437 Cherry Street, #109, Newton, Massachusetts 02465 Phone: (617) 558-0101 E-Mail: Lamsoneng@msn.com				Boring No. BB-5		Page 1/1	
						Scale: 1" = 5'			
City/Town: Wilmington		Bridge No.: W-38-003 (2NV)		Project File No.: 608929		Contract No.: -			
Location: Butters Row over MBTA/PAN AM Railroad				Date & Time Started: 1/11/21 1:30 p.m.		Total Hours:			
Groundwater Depth (Feet): 5.5' Date & Time: 1/12/21 9:00 a.m.				Date & Time Completed: 1/12/21 9:30 a.m.		4.5			
Coordinates: N 3,021,479		E 746,453		Ground Elevation (Feet): 88.7'		Inspector's Name: Weijie Dong			
Drilling Company: New England Boring Contractors				Driller's Name: Brett Raiche		Helper's Name: Brian Steen			
Sample Number	Depth Range (Feet)	Blow Counts per 6 Inches Coring Times Minute Per Foot				Recovery (inches)	Field Description		Strata Changes
S-1	0' - 2'	8	16	18	14	10"	Topsoil 4" Dry, dense, brown, FINE TO COARSE SAND, some fine gravel, trace inorganic silt.		
S-2	4' - 6'	6	8	12	14	13"	Dry, medium dense, brown, FINE SAND, trace wood, trace inorganic silt.		
S-3	9' - 11'	3	3	4	4	12"	Wet, loose, brown, FINE SAND, some inorganic silt.		
S-4	14' - 16'	1	2	6	42	8"	Wet, loose, gray, FINE SAND, some inorganic silt. Possible Top of Bedrock @ 17'		17'
							Rollerbit to 18'6".		18'6"
							Bottom of Exploration @ 18'6"		
Notes:						Arrow-Board: - Signs: - Cones: -		Protective Device Stand: - Box: - Well Depth: - Solid Pipe: - Stick Up Pipe: - Screen Pipe: -	
Penetration Resistance (N) Guide:								Type of Drill Rig: Soil Scout	
Cohesionless Soils (Sands, Gravels)				Cohesive Soils (Silts, Clays)				Hammer Weight: 140 lbs Fall: 30"	
Relative Density		Penetration Resistance		Consistency		Penetration Resistance		Casing Types: HW	
Very Loose		0 - 4		Very Soft		0 - 2		Size: 4"	
Loose		4 - 10		Soft		2 - 4		Depth: 14'	
Medium Dense		10 - 30		Medium Stiff		4 - 8		Sampler Type: S/S Size: 1 3/8" ID	
Dense		30 - 50		Stiff		8 - 15		Automatic Hammer Weight:	
Very Dense		Over 50		Very Stiff		15 - 30		Safety Hammer Weight: 140 lbs	
N=Sum of Second and Third 6" Blow Counts				Hard		Over 30		Donut Hammer Weight: Fall: 30"	
Terms Used for Second Entry of Descriptions: and = 40-50%, some = 10-40%, trace = 10% or less								Core Barrel Type: - Size: -	

Soil Sample Recovery Photos

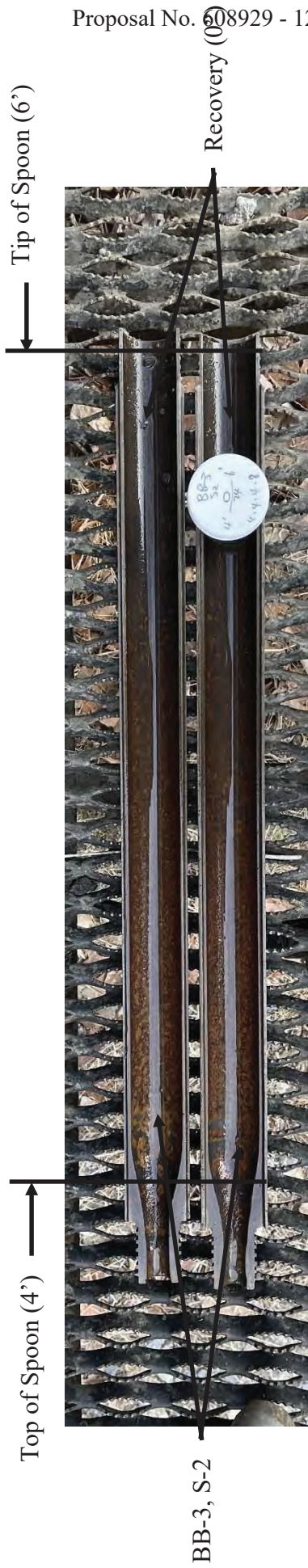
Boring Number	Sample Number	Page Number
BB-1	S1, S2, & S4	1/9
	S5, S6, & S7	2/9
BB-2B	S1, S2, & S3	3/9
	S4, S5, & S6	4/9
BB-3	S1, S2, & S3	5/9
	S4 & S5	6/9
BB-4	S1	
	S2, S3, & S4	7/9
	S5	8/9
BB-5	S1 & S2	
	S3 & S4	9/9

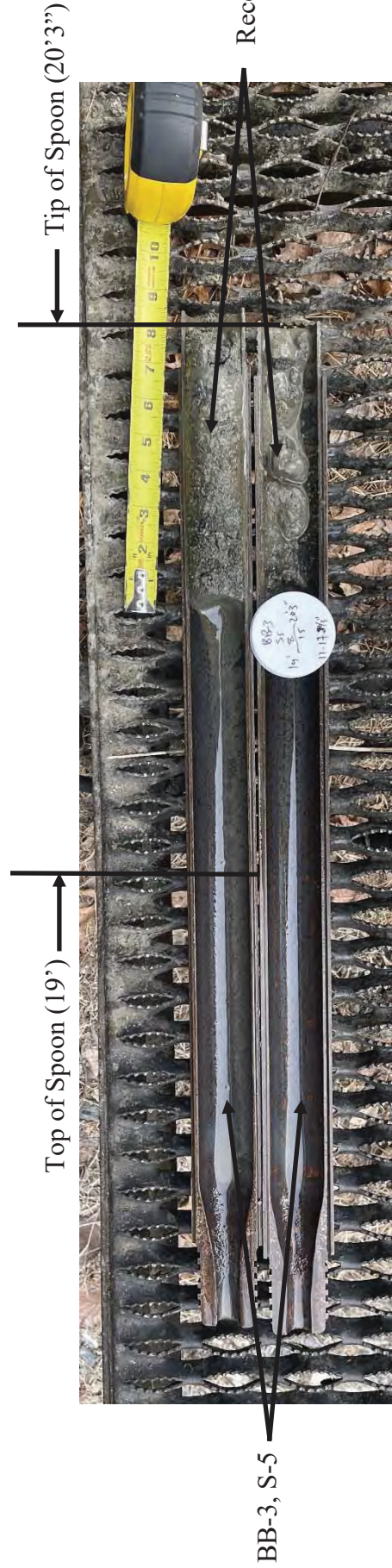


















Bedrock Cores Recovery Photo

Boring BB-3:
Core 1 (Granite Gneiss)
REC: 100% RQD: 83%

Boring BB-3:
Core 2 (Granite Gneiss)
REC: 100% RQD: 88%

Boring BB-1:
Core 1 (Diorite)
REC: 100% RQD: 100%

Boring BB-1:
Core 2 (Diorite)
REC: 100% RQD: 90%

Buttress Row / NETA / PAU Am RR
Wilmington, MA
Bridge No. W-38-003 (2.110)
Project No. 608929
New England Boring Contractors
BB-3 C.F.C.
BB-1 C.F.C.

Boring No.	Core No.	Depth	NFE	REC	RQD
BB-3	C1	20' - 25'	5.66.3.6	60"	50/60 = 83%
	C2	15.5' - 30.5'	6.5.5.6.6	60"	53/60 = 88%
BB-1	C1	34' - 39'	4.4.5.5.4	60"	100%
	C2	35' - 44'	4.5.4.5.4	60"	58/60 = 90%

Top of Core

Boring BB-2B:
Core 1 (Granodiorite)
REC: 83% RQD: 83%

Boring BB-2B:
Core 2 (Granite Gneiss)
REC: 97% RQD: 83%

Buttress Row / NETA / PAU Am RR
Wilmington, MA
Bridge No. W-38-003 (2.110)
Project No. 608929
New England Boring Contractors
BB-2B C.F.C.

Boring No.	Core No.	Depth	NFE	REC	RQD
BB-2B	C1	34' - 39'	3.3.4.5.5	50"	50/60 = 83%
	C2	39' - 44'	4.5.5.5.6	58"	50/60 = 83%

Top of Core




Client:	Lamson Engineering Corporation		
Project:	Bridge No. W-38-003 (2NY) - 123406		
Location:	Wilmington, MA	Project No:	GTX-313070
Boring ID:	BB-2B	Sample Type:	cylinder
Sample ID:	Elev_69.5 to 68.5	Test Date:	01/26/21
Depth :	32-33 ft	Test Id:	608419
Test Comment:	---		
Visual Description:	See photograph(s)		
Sample Comment:	---		

Bulk Density and Compressive Strength of Rock Core Specimens by ASTM D7012 Method C

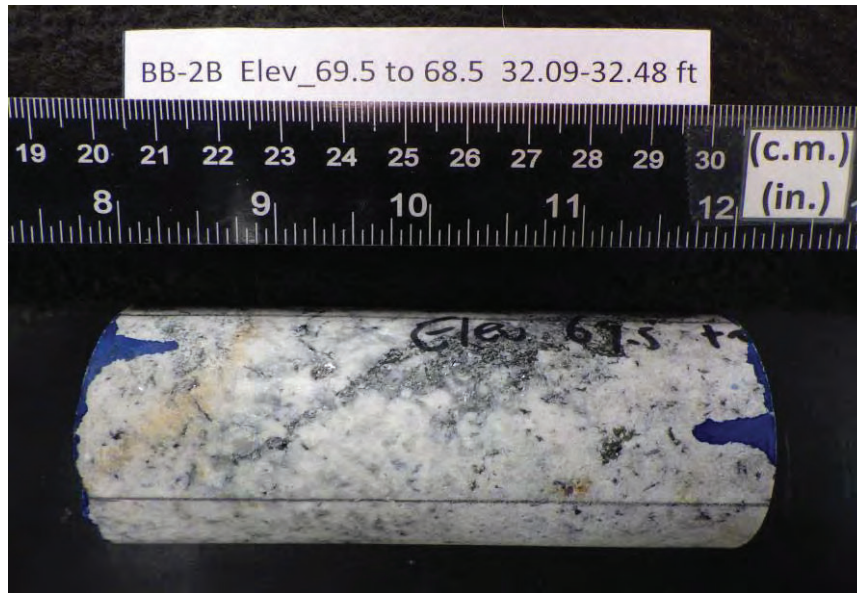
Boring ID	Sample Number	Depth	Bulk Density, pcf	Compressive strength, psi	Failure Type	Meets ASTM D4543	Note(s)
BB-2B	Elev_69.5 to 68.5	32.09-32.48 ft	164	23836	1	Yes	---

Notes: Density determined on core samples by measuring dimensions and weight and then calculating.
All specimens tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Failure Type: 1 = Intact Material Failure; 2 = Discontinuity Failure; 3 = Intact Material and Discontinuity Failure
(See attached photographs)

	Client: Lamson Engineering Corporation Project Name: Bridge No. W-38-003 (2NW) Project Location: Wilmington, MA GTX #: 313070	Test Date: 1/22/2021 Tested By: cmh Checked By: smd
	Boring ID: BB-2B Sample ID: Elev. 69.5 to 68.5 Depth: 32.09-32.48 ft Visual Description: See photographs	

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543									
BULK DENSITY			DEVIATION FROM STRAIGHTNESS (Procedure S1)						
Specimen Length, in: 1 Specimen Diameter, in: 4.57 Specimen Mass, g: 1.99 Bulk Density, lb/ft ³ : 611.34 Length to Diameter Ratio: 2.3			Average 4.57 1.99			Maximum gap between side of core and reference surface plate: Is the maximum gap ≤ 0.02 in.? YES			
Minimum Diameter Tolerance Met?			Straightness Tolerance Met?						
Length to Diameter Ratio Tolerance Met?			YES			Maximum difference must be < 0.020 in.			
YES			YES			YES			
END FLATNESS AND PARALLELISM (Procedure FP1)									
END 1									
Diameter 1, in		-0.875 -0.00030 0.00000		-0.750 -0.00020 0.00000		-0.625 -0.00010 0.00000		0.250 0.00020 0.00000	
Diameter 2, in (rotated 90°)		0.00000		0.00000		0.00000		0.00000	
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Client:	Lamson Engineering Corporation
Project Name:	Bridge No. W-38-003 (2NV)
Project Location:	Wilmington, MA
GTX #:	313070
Test Date:	1/22/2021
Tested By:	cmh
Checked By:	smd
Boring ID:	BB-2B
Sample ID:	Elev_69.5-68.5
Depth, ft:	32.09-32.48



After cutting and grinding



After break

APPENDIX 2

Calculations

INDEX OF CALCULATIONS

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LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:	Preliminary Sheet No.:	
Subject: 10.75" Diameter Micropile Foundation	Prepared by: SL	Date: 12/2022	
Detail: Summary of Abutment Micropile Resistance	Checked by: JG	Date: 12/2022	

1. Summary of Proposed Abutment Micropile Resistance

Abutment (3 rows each of 13 micropiles for each abutment, total 39 Piles)

Wingwall Type 1 (3 rows, front row of piles battered 1:4)

Steel Casing: 10.75" O.D. x 0.595", API 52 ($F_y = 52$ ksi), Wall Thickness = 0.595 in, Area = 18.98 in²

Steel Reinforcing Bar: #14, Threaded, Grade 60

Rock Socket Diameter = 9.56 in

Estimated Bonded Length into Rock (Grout into Rock)	7 ft
Plunge Length (Casing into Rock)	1 ft
Nominal Geotechnical Pile Resistance per Pile	378 kips
Side Resistance Factor, ϕ_{stat}	0.55
Factored Geotechnical Pile Resistance per Pile	208 kips
Nominal Uplift Resistance per Pile	189 kips
Resistance Factor, ϕ_{up}	0.55
Factored Uplift Resistance per Pile	104 kips

Nominal Structural Pile Resistance per Pile	= 1097 kips	(Portion of Cased Length) – Note 1
Nominal Structural Pile Resistance per Pile	= 366 kips	(Portion of Uncased Length) – Note 1
Compression Resistance Factor, ϕ_c	= 0.75	
Factored Structural Pile Resistance per Pile	= 823 kips	(Portion of Cased Length)
Factored Structural Pile Resistance per Pile	= 274 kips	(Portion of Uncased Length)
Nominal Tension Resistance	= 995 kips	(Portion of Cased Length)
Nominal Tension Resistance	= 135 kips	(Portion of Uncased Length)
Tension Resistance Factor, ϕ_T	= 0.80	
Factored Tension Resistance	= 796 kips	(Portion of Cased Length)
Factored Tension Resistance	= 108 kips	(Portion of Uncased Length)

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:	Preliminary Sheet No.:	
Subject: 10.75" Diameter Micropile Foundation	Prepared by: SL	Date: 12/2022	
Detail: Summary of Retaining Wall Micropile Resistance	Checked by: JG	Date: 12/2022	

2. Summary of Proposed Wingwall Type 2 and 2A Micropile Resistance

Wingwall Type 2 & 2A (3 rows, front row of piles battered 1:4)

Steel Casing: 10.75" O.D. x 0.595", API 52 ($F_y = 52$ ksi), Wall Thickness = 0.595 in, Area = 18.98 in²

Steel Reinforcing Bar: #14, Threaded, Grade 60

Rock Socket Diameter = 9.56 in

Estimated Bonded Length into Rock (Grout into Rock)	5.5 ft
Plunge Length (Casing into Rock)	1 ft
Nominal Geotechnical Pile Resistance per Pile	297 kips
Side Resistance Factor, ϕ_{stat}	0.55
Factored Geotechnical Pile Resistance per Pile	164 kips
Nominal Uplift Resistance per Pile	149 kips
Resistance Factor, ϕ_{up}	0.55
Factored Uplift Resistance per Pile	82 kips

Nominal Structural Pile Resistance per Pile	= 1097 kips	(Portion of Cased Length)
Nominal Structural Pile Resistance per Pile	= 366 kips	(Portion of Uncased Length)
Compression Resistance Factor, ϕ_c	= 0.75	
Factored Structural Pile Resistance per Pile	= 823 kips	(Portion of Cased Length)
Factored Structural Pile Resistance per Pile	= 274 kips	(Portion of Uncased Length)
Nominal Tension Resistance	= 995 kips	(Portion of Cased Length)
Nominal Tension Resistance	= 135 kips	(Portion of Uncased Length)
Tension Resistance Factor, ϕ_T	= 0.80	
Factored Tension Resistance	= 796 kips	(Portion of Cased Length)
Factored Tension Resistance	= 108 kips	(Portion of Uncased Length)

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:		Preliminary Sheet No.:
Subject: 10.75" Diameter Micropile Foundation	Prepared by: SL		Date: 12/2022
Detail: Summary of Retaining Wall Micropile Resistance	Checked by: JG		Date: 12/2022





Summary of Micropile Shear Resistance at 1" Displacement

Type	Abutment	Wingwall Type 1	Wingwall Types 2 & 2A
10.75" x 0.595" Micropile	52 kips	37 kips	28 kips

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS		Date: 6/2022
Detail: Unfactored Vertical Load	Checked by: FL		Date: 6/2022

Abutment Wall Abutment Length 50 ft Footing 55.6875 ft

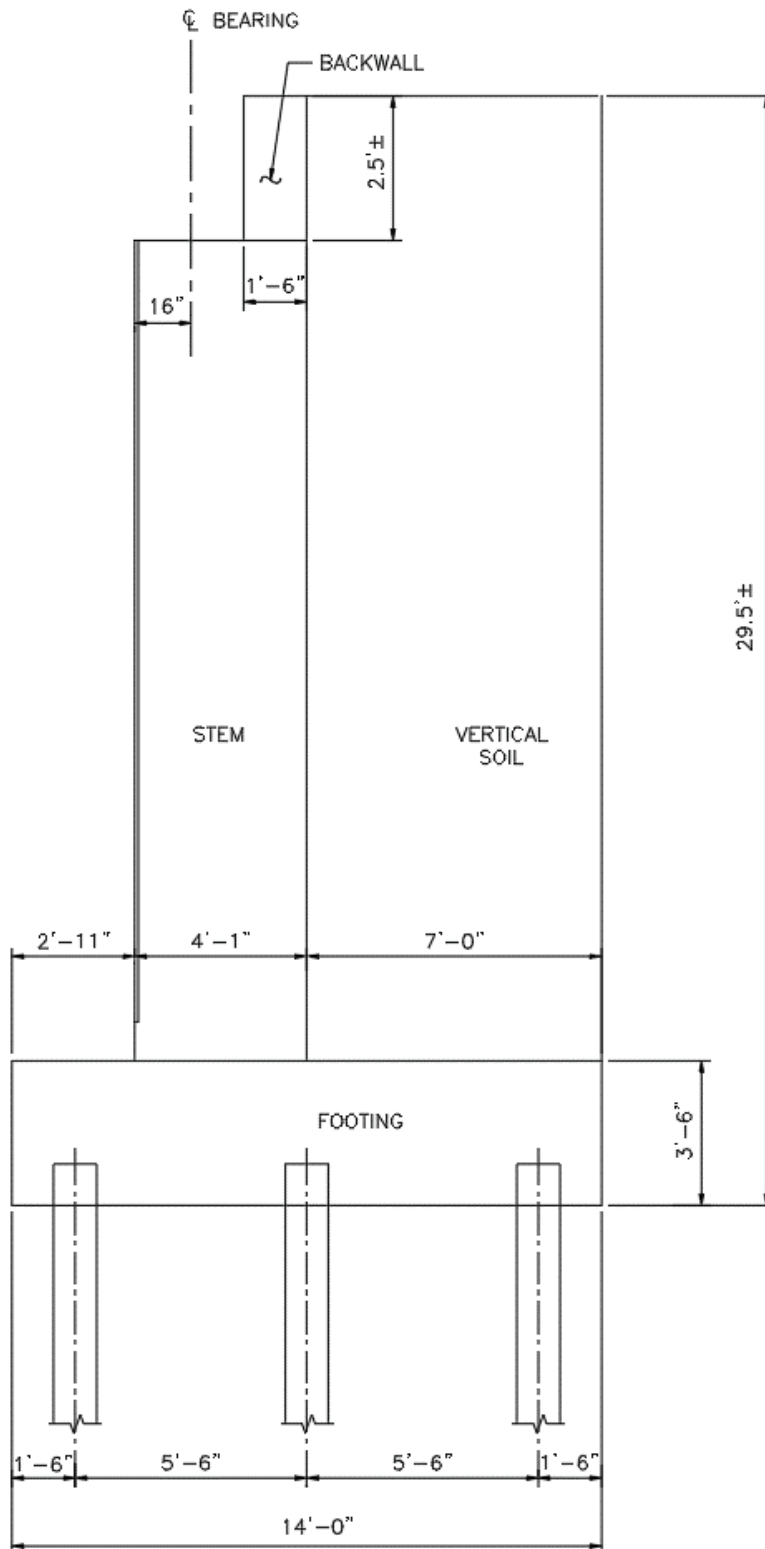
Unfactored Vertical Load

	W (ft)	H (ft)	L (ft)	Unit Weight		
Backwall	(1.50)	(2.50)	(50.00)	(0.15 kcf)	=	28.13 kips
Stem 1 	(4.08)	(23.50)	(50.00)	(0.15 kcf)	=	719.69 kips
Stem 2 	0.5 (0.00)	(23.50)	(50.00)	(0.15 kcf)	=	0.00 kips
Concrete Footing	(14.00)	(3.50)	(55.69)	(0.15 kcf)	=	409.30 kips
Vertical Soil 1 	0.5 (0.00)	(26.50)	(55.69)	(0.12 kcf)	=	0.00 kips
Vertical Soil 2 	(7.00)	(26.50)	(55.69)	(0.12 kcf)	=	1239.60 kips
Curtain Walls (provided)					=	4.34 kips

Unfactored Loads from Green

Approach Slab (DC)	=	20	kips
Superstructure Dead (DC)	=	169.90	kips
Wearing Surface (DW)	=	26.10	kips
Live from Superstructure (LL)	=	136.40	kips
Braking Force (BR _H)	=	17.60	kips
Braking Force (BR _V)	=	3.90	kips
Wind from Superstructure, WS _H	=	0.30	kips
Wind from Superstructure, WS _V	=	0.00	kips
Wind from Vehicle, WL _H	=	1.20	kips
Wind from Vehicle, WL _V	=	0.30	kips
Thermal Force, TU	=	12.70	kips
Seismic Force, EQ	=	21.30	kips
Crash Loads, CT	=	-660.000	kips

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Unfactored Vertical Load	Checked by: FL	Date: 6/2022	



LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL	Date: 6/2022
Detail: Lateral earth pressure	Checked by: SS	Date: 6/2022

Determine Unfactored Horizontal Load

Effective angle of internal friction ϕ'_f	=	37	degree
Friction angle between fill and wall, δ	=	0.0	degree
Angle of fill to the horizontal, β	=	0.0	degree
Angle of back of wall to the horizontal, θ	=	90	degree
Unit weight of soil, γ_{soil}	=	0.125	kcf
Total unit weight of water, γ_w	=	0.0624	kcf
Height of Soil	=	30.00	ft ±
Distance from back of wall to footing heel, B_{heel}	=	7.00	ft
Height of fill behind footing at heel, $h = H + B_{heel} \tan \beta$	=	30.00	ft ±
Height of water from bottom of footing, H_w	=	0	ft

Lateral Earth Pressure (EH)

$$K_a = \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta) \left[1 + \sqrt{\frac{\sin(\phi'_f + \delta) \sin(\phi'_f - \beta)}{\sin(\theta - \delta) \sin(\theta + \beta)}} \right]^2}$$

$$= 0.249$$

$$K_o = 1 - \sin \phi'_f = 1 - \sin(37)$$

$$= 0.398$$

Per *massDOT* LRFD BM 3.1.5

Founded on Pile = Y (Input Y if yes)

$$K_e = K_o = 0.398$$

$$P_{e1} = 0.5 K_e \gamma_{soil} (h - H_w)^2$$

$$= 0.5 \times 0.398 \times 0.125 \text{ kcf} \times (30 \text{ ft} - 0 \text{ ft})^2$$

$$= 22.40 \text{ k/ft length of wall}$$

$$P_{ev1} = P_{e1} \sin(90 - \theta + \delta)$$

$$= 22.4 \text{ k/ft} \times \sin(90 - 90 + 0)$$

$$= 0.00 \text{ k/ft}$$

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Detail: Lateral earth pressure	Checked by: SS	Date: 6/2022

$$\begin{aligned}
 \text{Horizontal component of } P_{e1}, P_{eh1} &= P_{e1} \cos (90 - \theta + \delta) \\
 &= 22.4 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 22.40 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Lateral earth pressure, } P_{e2} &= K_e \gamma_{\text{soil}} (h - H_w) H_w \\
 &= 0.398 \times 0.125 \text{ kcf} \times (30 \text{ ft} - 0 \text{ ft}) \times 0 \text{ ft} \\
 &= 0.00 \text{ k/ft length of wall}
 \end{aligned}$$

$$\begin{aligned}
 \text{Vertical component of } P_{e2}, P_{ev2} &= P_{e2} \sin (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Horizontal component of } P_{e2}, P_{eh2} &= P_{e2} \cos (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Lateral earth pressure, } P_{e3} &= 0.5 K_e \gamma' (H_w)^2 \\
 &= 0.5 \times 0.398 \times (0.125 \text{ kcf} - 0.0624 \text{ kcf}) \times 0 \text{ ft}^2 \\
 &= 0.00 \text{ k/ft length of wall}
 \end{aligned}$$

$$\begin{aligned}
 \text{Vertical component of } P_{e3}, P_{ev3} &= P_{e3} \sin (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Horizontal component of } P_{e3}, P_{eh3} &= P_{e3} \cos (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

Live Load Surcharge (LS) (AASHTO LRFD 3.11.6.4)

$$\text{Equivalent height of soil for, } h_{eq} = 0.000 \text{ ft}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:
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Detail: Lateral earth pressure	Checked by: SS	Date: 6/2022

$$\begin{aligned} \text{Vertical live load Surcharge on heel, LS} &= 0.125 \text{ kcf} \times 0 \text{ ft} \times 7 \text{ ft} \\ &= 0.000 \text{ k / ft} \end{aligned}$$

$$\begin{aligned} \text{Horizontal earth pressure due to live load surcharge } \Delta_p &= K_e \gamma_{\text{soil}} h_{eq} \\ &= 0.398 \times 0.125 \text{ kcf} \times 0 \text{ ft} \\ &= 0.00 \text{ ksf} \end{aligned}$$

$$\begin{aligned} \text{Live load lateral earth pressure, } P_{LS} &= \Delta_p h \\ &= 0 \text{ ksf} \times 30 \text{ ft} \\ &= 0.00 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Vertical component of } P_{LS}, P_{LSV} &= P_{LS} \sin (90 - \alpha + \delta) \\ &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\ &= 0.00 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Horizontal component of } P_{LS}, P_{LSH} &= P_{LS} \cos (90 - \alpha + \delta) \\ &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\ &= 0.00 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Unfactored horizontal load, EH + LSH} &= P_{eh1} + P_{eh2} + P_{eh3} + P_{LSH} \\ &= 22.4 + 0 + 0 + 0 \\ &= \underline{22.40 \text{ k/ft length of wall}} \end{aligned}$$

Seismic Load (EQ)

$$\begin{aligned} \text{Backfill slope angle, } i &= 0 \\ \text{Slope of wall to the vertical, } \beta &= 0 \\ \text{Acceleration coefficient, } A_s &= 0.096 \\ \text{Horizontal seismic coefficient, } k_h &= 0.096 \text{ nonyielding abutment or wall} \end{aligned}$$





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Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL	Date: 6/2022
Detail: Lateral earth pressure	Checked by: SS	Date: 6/2022

$$\begin{aligned}
 \text{Vertical seismic coefficient, } k_v &= 0 \\
 \Theta = \text{arc tan } (k_h/(1-k_v)) &= 5.48 \text{ degrees} \\
 \text{Seismic active pressure coefficient, } K_{AE} &= \frac{\cos^2(\phi - \theta - \beta)}{\cos \theta \cos^2 \beta \cos(\delta + \beta + \theta) \left[1 + \sqrt{\frac{\sin(\phi + \delta) \sin(\phi - \theta - i)}{\cos(\delta + \beta + \theta) \cos(i - \beta)}} \right]^2} \\
 &= 0.301 \\
 \text{Active seismic force on back of wall, } P_{AE} &= 0.5 K_{AE} \gamma_{\text{soil}} (H)^2 \\
 &= 0.5 \times (0.301) \times 0.125 \text{ kcf} \times (30 \text{ ft})^2 \\
 &= 16.91 \text{ k/ft} \\
 \text{Vertical component of } P_{EQ}, P_{EQV} &= P_{EQ} \sin(\beta + \delta) \\
 &= 0.00 \text{ k/ft} \\
 \text{Horizontal component of } P_{EQ}, P_{EQH} &= P_{EQ} \cos(\beta + \delta) \\
 &= 16.91 \text{ k/ft} \\
 \text{Seismic force from superstructure} &= (A) (DL) \\
 &= 18.82 \text{ k/ft} \\
 \text{Seismic inertia force} &= W_i k_h
 \end{aligned}$$

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project: Bridge No. W-38-003	Job No.:		Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022	
Detail: Strength I for Overturning	Checked by: SS		Date: 6/2022	

Summary of Factored Loads - Strength IA: 1.25DC + 1.35EH + 1.35EV + 1.75 LS + 1.75 (LL+BR) + 0.5 TU

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about CL Footing	Factored Moment	
Backwall	1.25	28.13	35.16	0.75	26.37	
Stem 1 	1.25	724.03	905.03	2.04	1847.78	
Stem 2 	1.25	0.00	0.00	0.00	0.00	
Concrete Footing	1.25	409.30	511.63	0.00	0.00	
Vertical Soil 1 	1.35	0.00	0.00	0.00	0.00	
Vertical Soil 2 	1.35	1239.60	1673.47	-3.50	-5857.13	
Approach Slab (DC)	1.25	20.00	25.00	-5.00	-125.00	
Superstructure Dead (DC)	1.25	169.90	212.38	2.75	584.03	
Wearing Surface (DW)	1.50	26.10	39.15	2.75	107.66	
Live from Superstrcutre (LL)	1.75	136.40	238.70	2.75	656.43	
Braking Force (BRV)	1.75	3.90	6.83	2.75	18.77	
Thermal Force, TU	0.50	0.00	0.00	2.75	0.00	
P_{v1}	1.35	0.00	0.00	-7.00	0.00	
P_{v2}	1.35	0.00	0.00	-7.00	0.00	
P_{v3}	1.35	0.00	0.00	-7.00	0.00	
P_{LSV}	1.75	0.00	0.00	-7.00	0.00	
LS	1.75	0.00	0.00	-3.50	0.00	
TOTAL		2757.36	3647.33		-2741.09	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about CL Footing	Factored Moment	
P_{h1}	1.35	1119.90	1511.86	10.00	15118.59	
P_{h2}	1.35	0.00	0.00	0.00	0.00	
P_{h3}	1.35	0.00	0.00	0.00	0.00	
P_{LSH}	1.75	0.00	0.00	15.00	0.00	
Braking Force (BRH)	1.75	17.60	30.80	27.27	839.92	
Thermal Force, TU	0.00	12.70	0.00	27.27	0.00	
TOTAL		1150.20	1542.66		15958.50	ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_STR I_VMAX	Checked by: FL	Date: 6/2022	

Pile STR I_VMAX

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Load Parallel to Abutment From Green

Vertical, $F_z = 3647.33$ kips

$F_y = 1542.66$ kips

$F_x = 9.00$ kips

$M_x = 13217.41$ k-ft

$M_y = 239.00$ kips-ft

Pile #	A_p (sf)	X_i (ft.)	Y_i (ft.)	$A_p X_i$ (ft. ³)	$A_p Y_i$ (ft. ³)	dx^2 ($X_i - X_{CG}$) ²	dy^2 ($Y_i - Y_{CG}$) ²	$\frac{M_x(Y_i - Y_{CG})}{\sum (Y_i - Y_{CG})^2}$	$\frac{M_y(X_i - X_{CG})}{\sum (X_i - X_{CG})^2}$	F_z / n	$\sum F_z$ (kips)	Shear F_y / n	Shear F_x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-92.43	-0.66	93.521	0.44	39.56	0.23
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-92.43	-0.55	93.521	0.54	39.56	0.23
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-92.43	-0.44	93.521	0.65	39.56	0.23
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-92.43	-0.33	93.521	0.76	39.56	0.23
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-92.43	-0.22	93.521	0.87	39.56	0.23
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-92.43	-0.11	93.521	0.98	39.56	0.23
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-92.43	0.00	93.521	1.09	39.56	0.23
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-92.43	0.11	93.521	1.20	39.56	0.23
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-92.43	0.22	93.521	1.31	39.56	0.23
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-92.43	0.33	93.521	1.42	39.56	0.23
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-92.43	0.44	93.521	1.53	39.56	0.23
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-92.43	0.55	93.521	1.64	39.56	0.23
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-92.43	0.66	93.521	1.75	39.56	0.23
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-0.66	93.521	92.86	39.56	0.23
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-0.55	93.521	92.97	39.56	0.23
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-0.44	93.521	93.08	39.56	0.23
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.33	93.521	93.19	39.56	0.23
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.22	93.521	93.30	39.56	0.23
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.11	93.521	93.41	39.56	0.23
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	93.521	93.52	39.56	0.23
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.11	93.521	93.63	39.56	0.23
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.22	93.521	93.74	39.56	0.23
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.33	93.521	93.85	39.56	0.23
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	0.44	93.521	93.96	39.56	0.23
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	0.55	93.521	94.07	39.56	0.23
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	0.66	93.521	94.18	39.56	0.23
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	92.43	-0.66	93.521	185.29	39.56	0.23
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	92.43	-0.55	93.521	185.40	39.56	0.23
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	92.43	-0.44	93.521	185.51	39.56	0.23
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	92.43	-0.33	93.521	185.62	39.56	0.23
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	92.43	-0.22	93.521	185.73	39.56	0.23
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	92.43	-0.11	93.521	185.84	39.56	0.23
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	92.43	0.00	93.521	185.95	39.56	0.23
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	92.43	0.11	93.521	186.06	39.56	0.23
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	92.43	0.22	93.521	186.17	39.56	0.23
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	92.43	0.33	93.521	186.28	39.56	0.23
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	92.43	0.44	93.521	186.39	39.56	0.23
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	92.43	0.55	93.521	186.50	39.56	0.23
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	92.43	0.66	93.521	186.61	39.56	0.23
	24.58			0.00	0.00						186.61	39.56	0.23

$$Y_{CG} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

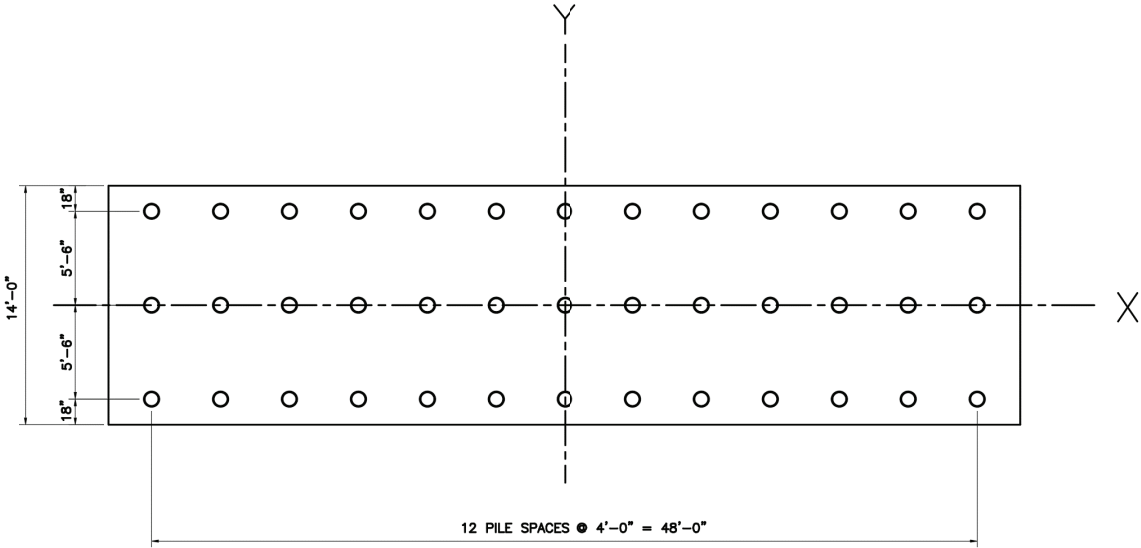
$$Y_{CG} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{CG})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{CG})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (39.56^2 + 0.23^2)^{0.5} = 39.56 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:	
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Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_STR I_VMAX	Checked by: FL	Date: 6/2022	



ABUTMENT MICROPILE PLAN

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project:	Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject:	Abutment - 10.75 Dia Micropile	Prepared by: FL	Date: 6/2022	
Detail:	Strength IB for Sliding and Eccentricity	Checked by: SS	Date: 6/2022	

Summary of Factored Loads - Strength IB: 0.90DC + 1.35EH + 1.0EV + 1.75 LS + 1.75 (LL+BR) + 0.5 TU

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⌄ Footing	Factored Moment	
Backwall	0.90	28.13	25.31	0.75	18.98	
Stem	0.90	724.03	651.62	2.04	1330.40	
Stem 2	0.90	0.00	0.00	0.00	0.00	
Concrete Footing	0.90	409.30	368.37	0.00	0.00	
Vertical Soil 1	1.00	0.00	0.00	0.00	0.00	
Vertical Soil 2	1.00	1239.60	1239.60	-3.50	-4338.61	
Approach Slab (DC)	0.90	20.00	18.00	-5.00	-90.00	
Superstructure Dead (DC)	0.90	169.90	152.91	2.75	420.50	
Wearing Surface (DW)	0.65	26.10	16.97	2.75	46.65	
Live from Superstrucutre (LL)	1.75	136.40	238.70	2.75	656.43	
Braking Force (BRV)	1.75	3.90	6.83	2.75	18.77	
Thermal Force, TU	0.50	0.00	0.00	2.75	0.00	
P_{v1}	1.35	0.00	0.00	-7.00	0.00	
P_{v2}	1.35	0.00	0.00	-7.00	0.00	
P_{v3}	1.35	0.00	0.00	-7.00	0.00	
P_{LSV}	1.75	0.00	0.00	-7.00	0.00	
LS	1.75	0.00	0.00	-3.50	0.00	
TOTAL		2757.36	2718.31		-1936.88	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about ⌄ Footing	Factored Moment	
P_{h1}	1.35	1119.90	1511.86	10.00	15118.59	
P_{h2}	1.35	0.00	0.00	0.00	0.00	
P_{h3}	1.35	0.00	0.00	0.00	0.00	
P_{LSH}	1.75	0.00	0.00	15.00	0.00	
Braking Force (BRH)	1.75	17.60	30.80	27.27	839.92	
Thermal Force, TU	0.00	12.70	0.00	27.27	0.00	
TOTAL		1150.20	1542.66		15958.50	ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_STR I Mmax	Checked by: FL	Date: 6/2022	

Pile STR I Mmax

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, F_z = **2718.31 kips**

F_y = **1542.66 kips**

F_x = **9.00 kips**

M_x = **14021.62 k-ft**

M_y = **239.00 kips-ft**

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	M _x (Y _i - Y _{C.G.}) Σ (Y _i - Y _{C.G.}) ²	M _y (X _i - X _{C.G.}) Σ (X _i - X _{C.G.}) ²	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-98.05	-0.66	69.700	-29.01	39.56	0.23
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-98.05	-0.55	69.700	-28.90	39.56	0.23
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-98.05	-0.44	69.700	-28.79	39.56	0.23
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-98.05	-0.33	69.700	-28.68	39.56	0.23
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-98.05	-0.22	69.700	-28.57	39.56	0.23
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-98.05	-0.11	69.700	-28.46	39.56	0.23
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-98.05	0.00	69.700	-28.35	39.56	0.23
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-98.05	0.11	69.700	-28.24	39.56	0.23
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-98.05	0.22	69.700	-28.13	39.56	0.23
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-98.05	0.33	69.700	-28.02	39.56	0.23
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-98.05	0.44	69.700	-27.92	39.56	0.23
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-98.05	0.55	69.700	-27.81	39.56	0.23
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-98.05	0.66	69.700	-27.70	39.56	0.23
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-0.66	69.700	69.04	39.56	0.23
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-0.55	69.700	69.15	39.56	0.23
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-0.44	69.700	69.26	39.56	0.23
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.33	69.700	69.37	39.56	0.23
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.22	69.700	69.48	39.56	0.23
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.11	69.700	69.59	39.56	0.23
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	69.700	69.70	39.56	0.23
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.11	69.700	69.81	39.56	0.23
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.22	69.700	69.92	39.56	0.23
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.33	69.700	70.03	39.56	0.23
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	0.44	69.700	70.14	39.56	0.23
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	0.55	69.700	70.25	39.56	0.23
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	0.66	69.700	70.36	39.56	0.23
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	98.05	-0.66	69.700	167.10	39.56	0.23
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	98.05	-0.55	69.700	167.21	39.56	0.23
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	98.05	-0.44	69.700	167.32	39.56	0.23
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	98.05	-0.33	69.700	167.43	39.56	0.23
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	98.05	-0.22	69.700	167.53	39.56	0.23
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	98.05	-0.11	69.700	167.64	39.56	0.23
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	98.05	0.00	69.700	167.75	39.56	0.23
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	98.05	0.11	69.700	167.86	39.56	0.23
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	98.05	0.22	69.700	167.97	39.56	0.23
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	98.05	0.33	69.700	168.08	39.56	0.23
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	98.05	0.44	69.700	168.19	39.56	0.23
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	98.05	0.55	69.700	168.30	39.56	0.23
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	98.05	0.66	69.700	168.41	39.56	0.23
	24.58			0.00	0.00						168.41	39.56	0.23

$$X_{C.G.} = \Sigma A_p X_i / \Sigma A_p = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \Sigma A_p Y_i / \Sigma A_p = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\Sigma (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\Sigma (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (39.56^2 + 0.23^2)^{0.5} = 39.56 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail: Extreme Event I: 100% PAE + 50% PIR	Checked by: SS		Date: 6/2022

Summary of Factored Loads - 100% P_{AE} + 50 % P_{IR}

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⌚ Footing	Factored Moment	
Backwall	1.00	28.13	28.13	0.75	21.09	
Stem 1	1.00	724.03	724.03	2.04	1478.22	
Stem 2	1.00	0.00	0.00	0.00	0.00	
Concrete Footing	1.00	409.30	409.30	0.00	0.00	
Vertical Soil 1	1.00	0.00	0.00	0.00	0.00	
Vertical Soil 2	1.00	1239.60	1239.60	-3.50	-4338.61	
Approach Slab (DC)	1.00	20.00	20.00	-5.00	-100.00	
Superstructure Dead (DC)	1.00	169.90	169.90	2.75	467.23	
Wearing Surface (DW)	1.00	26.10	26.10	2.75	71.78	
Live from Superstrucutre (LL)	0.00	136.40	0.00	2.75	0.00	
Braking Force (BRV)	0.00	3.90	0.00	2.75	0.00	
TOTAL		2757.36	2617.06		-2400.30	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about ⌚ Footing	Factored Moment	
Seismic Force, EQ	1.00	21.30	21.30	27.27	580.85	
Braking Force (BRH)	0.00	17.60	0.00	27.27	0.00	
Seismic Active Pressure, P_{AE}	1.00	845.27	845.27	10.00	8452.72	
$K_h W_{backwall}$	0.50	2.70	1.35	28.25	38.14	
$K_h W_{stem 1}$	0.50	69.51	34.75	15.25	529.99	
$K_h W_{stem 2}$	0.50	0.00	0.00	11.33	0.00	
$K_h W_{soil 1}$	0.50	39.29	19.65	13.25	260.32	
$K_h W_{soil 2}$	0.50	0.00	0.00	8.83	0.00	
TOTAL		995.67	922.32		9862.01	ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_EXT IA	Checked by: FL	Date: 6/2022	

Pile_EXT IA

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, F_z = **2617.06 kips**

F_y = **922.32 kips**

F_x = **22.00 kips**

M_x = **7461.71 k-ft**

M_y = **582.00 kips-ft**

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	$\frac{M_x(Y_i - Y_{C.G.})}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_i - X_{C.G.})}{\sum (X_i - X_{C.G.})^2}$	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-52.18	-1.60	67.104	13.33	23.65	0.56
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-52.18	-1.33	67.104	13.59	23.65	0.56
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-52.18	-1.07	67.104	13.86	23.65	0.56
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-52.18	-0.80	67.104	14.12	23.65	0.56
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-52.18	-0.53	67.104	14.39	23.65	0.56
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-52.18	-0.27	67.104	14.66	23.65	0.56
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-52.18	0.00	67.104	14.92	23.65	0.56
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-52.18	0.27	67.104	15.19	23.65	0.56
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-52.18	0.53	67.104	15.46	23.65	0.56
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-52.18	0.80	67.104	15.72	23.65	0.56
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-52.18	1.07	67.104	15.99	23.65	0.56
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-52.18	1.33	67.104	16.26	23.65	0.56
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-52.18	1.60	67.104	16.52	23.65	0.56
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-1.60	67.104	65.51	23.65	0.56
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-1.33	67.104	65.77	23.65	0.56
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-1.07	67.104	66.04	23.65	0.56
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.80	67.104	66.30	23.65	0.56
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.53	67.104	66.57	23.65	0.56
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.27	67.104	66.84	23.65	0.56
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	67.104	67.10	23.65	0.56
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.27	67.104	67.37	23.65	0.56
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.53	67.104	67.64	23.65	0.56
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.80	67.104	67.90	23.65	0.56
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	1.07	67.104	68.17	23.65	0.56
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	1.33	67.104	68.44	23.65	0.56
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	1.60	67.104	68.70	23.65	0.56
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	52.18	-1.60	67.104	117.69	23.65	0.56
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	52.18	-1.33	67.104	117.95	23.65	0.56
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	52.18	-1.07	67.104	118.22	23.65	0.56
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	52.18	-0.80	67.104	118.48	23.65	0.56
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	52.18	-0.53	67.104	118.75	23.65	0.56
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	52.18	-0.27	67.104	119.02	23.65	0.56
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	52.18	0.00	67.104	119.28	23.65	0.56
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	52.18	0.27	67.104	119.55	23.65	0.56
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	52.18	0.53	67.104	119.82	23.65	0.56
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	52.18	0.80	67.104	120.08	23.65	0.56
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	52.18	1.07	67.104	120.35	23.65	0.56
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	52.18	1.33	67.104	120.62	23.65	0.56
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	52.18	1.60	67.104	120.88	23.65	0.56
	24.58			0.00	0.00						120.88	23.65	0.56

$$X_{C.G.} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (23.65^2 + 0.56^2)^{0.5} = 23.66 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail: Extreme Event I: $\text{Max} (50\% P_{AE} + P_a) + 100 \% P_{IR}$	Checked by: SS		Date: 6/2022

Summary of Factored Loads - $\text{Max} (50\% P_{AE} + P_a) + 100 \% P_{IR}$

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⌚ Footing	Factored Moment
Backwall	1.00	28.13	28.13	0.75	21.09
Stem 1	1.00	724.03	724.03	2.04	1478.22
Stem 2	1.00	0.00	0.00	0.00	0.00
Concrete Footing	1.00	409.30	409.30	0.00	0.00
Vertical Soil 1	1.00	0.00	0.00	0.00	0.00
Vertical Soil 2	1.00	1239.60	1239.60	-3.50	-4338.61
Approach Slab (DC)	1.00	20.00	20.00	-5.00	-100.00
Superstructure Dead (DC)	1.00	169.90	169.90	2.75	467.23
Wearing Surface (DW)	1.00	26.10	26.10	2.75	71.78
Live from Superstructure (LL)	0.00	136.40	0.00	2.75	0.00
Braking Force (BRV)	0.00	3.90	0.00	2.75	0.00
TOTAL		2757.36	2617.06		-2400.30

ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about ⌚ Footing	Factored Moment
Seismic Force, EQ	1.00	21.30	21.30	27.27	580.85
Braking Force (BRH)	0.00	17.60	0.00	27.27	0.00
Max. (50% P_{AE} or P_a)	1.00	1119.90	1119.90	10.00	11198.95
$K_h W_{\text{backwall}}$	1.00	2.70	2.70	28.25	76.28
$K_h W_{\text{stem 1}}$	1.00	69.51	69.51	15.25	1059.98
$K_h W_{\text{stem 2}}$	1.00	0.00	0.00	11.33	0.00
$K_h W_{\text{soil 1}}$	1.00	39.29	39.29	13.25	520.63
$K_h W_{\text{soil 2}}$	1.00	0.00	0.00	8.83	0.00
TOTAL		1270.29	1252.69		13436.69

ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_EXT IB	Checked by: FL	Date: 6/2022	

Pile_EXT IB

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, F_z = **2617.06 kips**

F_y = **1252.69 kips**

F_x = **22.00 kips**

M_x = **11036.39 k-ft**

M_y = **582.00 kips-ft**

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	M _x (Y _i - Y _{C.G.}) Σ (Y _i - Y _{C.G.}) ²	M _y (X _i - X _{C.G.}) Σ (X _i - X _{C.G.}) ²	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-77.18	-1.60	67.104	-11.67	32.12	0.56
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-77.18	-1.33	67.104	-11.41	32.12	0.56
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-77.18	-1.07	67.104	-11.14	32.12	0.56
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-77.18	-0.80	67.104	-10.87	32.12	0.56
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-77.18	-0.53	67.104	-10.61	32.12	0.56
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-77.18	-0.27	67.104	-10.34	32.12	0.56
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-77.18	0.00	67.104	-10.07	32.12	0.56
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-77.18	0.27	67.104	-9.81	32.12	0.56
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-77.18	0.53	67.104	-9.54	32.12	0.56
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-77.18	0.80	67.104	-9.27	32.12	0.56
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-77.18	1.07	67.104	-9.01	32.12	0.56
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-77.18	1.33	67.104	-8.74	32.12	0.56
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-77.18	1.60	67.104	-8.47	32.12	0.56
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-1.60	67.104	65.51	32.12	0.56
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-1.33	67.104	65.77	32.12	0.56
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-1.07	67.104	66.04	32.12	0.56
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.80	67.104	66.30	32.12	0.56
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.53	67.104	66.57	32.12	0.56
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.27	67.104	66.84	32.12	0.56
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	67.104	67.10	32.12	0.56
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.27	67.104	67.37	32.12	0.56
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.53	67.104	67.64	32.12	0.56
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.80	67.104	67.90	32.12	0.56
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	1.07	67.104	68.17	32.12	0.56
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	1.33	67.104	68.44	32.12	0.56
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	1.60	67.104	68.70	32.12	0.56
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	77.18	-1.60	67.104	142.68	32.12	0.56
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	77.18	-1.33	67.104	142.95	32.12	0.56
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	77.18	-1.07	67.104	143.22	32.12	0.56
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	77.18	-0.80	67.104	143.48	32.12	0.56
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	77.18	-0.53	67.104	143.75	32.12	0.56
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	77.18	-0.27	67.104	144.02	32.12	0.56
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	77.18	0.00	67.104	144.28	32.12	0.56
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	77.18	0.27	67.104	144.55	32.12	0.56
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	77.18	0.53	67.104	144.81	32.12	0.56
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	77.18	0.80	67.104	145.08	32.12	0.56
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	77.18	1.07	67.104	145.35	32.12	0.56
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	77.18	1.33	67.104	145.61	32.12	0.56
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	77.18	1.60	67.104	145.88	32.12	0.56
	24.58			0.00	0.00						145.88	32.12	0.56

$$X_{C.G.} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (32.12^2 + 0.56^2)^{0.5} = 32.13 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL	Date: 6/2022
Detail: EXTREME EVENT II	Checked by: SS	Date: 6/2022

Summary of Factored Loads - Service I: 1.0DC + 1.0EH + 1.0EV + WS + WL + TU

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⌒ Footing	Factored Moment
Backwall	1.00	28.13	28.13	0.75	21.09
Stem	1.00	724.03	724.03	2.04	1478.22
Stem 2	1.00	0.00	0.00	0.00	0.00
Concrete Footing	1.00	409.30	409.30	0.00	0.00
Vertical Soil 1	1.00	0.00	0.00	0.00	0.00
Vertical Soil 2	1.00	1239.60	1239.60	-3.50	-4338.61
Approach Slab (DC)	1.00	20.00	20.00	-5.00	-100.00
Superstructure Dead (DC)	1.00	169.90	169.90	2.75	467.23
Wearing Surface (DW)	1.00	26.10	26.10	2.75	71.78
Live from Superstrucutre (LL)	0.50	136.40	68.20	2.75	187.55
Braking Force (BRV)	0.50	3.90	1.95	2.75	5.36
P_{v1}	1.00	0.00	0.00	-7.00	0.00
P_{v2}	1.00	0.00	0.00	-7.00	0.00
P_{v3}	1.00	0.00	0.00	-7.00	0.00
P_{LSV}	1.00	0.00	0.00	-7.00	0.00
LS	0.00	0.00	0.00	-3.50	0.00
TOTAL		2757.36	2687.21		-2207.38

ΣM_V

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about ⌒ Footing	Factored Moment
P_{h1}	0.00	0.00	0.00	10.00	0.00
P_{h2}	0.00	0.00	0.00	0.00	0.00
P_{h3}	0.00	0.00	0.00	0.00	0.00
P_{LSH}	0.00	0.00	0.00	15.00	0.00
Braking Force (BRH)	0.50	-17.60	-8.80	27.27	-239.98
Crash Load, CT	1.00	-660.00	-660.00	14.95	-9867.00
TOTAL		-677.60	-668.80		-10106.98

ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022
Detail: Pile_EXT II	Checked by: FL	Date: 6/2022

Pile EXT II

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, $F_z = 2687.21$ kips

$F_y = -668.80$ kips

$F_x =$ kips

$M_x = -12314.36$ k-ft

$M_y =$ kips-ft

Pile #	A_p (sf)	X_i (ft.)	Y_i (ft.)	$A_p X_i$ (ft. ³)	$A_p Y_i$ (ft. ³)	dx^2 $(X_i - X_{C.G.})^2$	dy^2 $(Y_i - Y_{C.G.})^2$	$\frac{M_x(Y_i - Y_{C.G.})}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_i - X_{C.G.})}{\sum (X_i - X_{C.G.})^2}$	F_z / n	$\sum F_z$ (kips)	Shear F_y / n	Shear F_x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	86.11	0.00	68.903	155.02	-17.15	0.00
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	0.00	68.903	68.90	-17.15	0.00
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	-86.11	0.00	68.903	-17.21	-17.15	0.00
	24.58			0.00	0.00						155.02	-17.15	0.00

$$X_{C.G.} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = -(17.15^2 + 0.00^2)^{0.5} = 17.15 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail: STR III	Checked by: SS		Date: 6/2022

Summary of Factored Loads - STR III: 1.25DC + 1.35EH + 1.35EV + WS + 0.5 TUVertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⌄ Footing	Factored Moment
Backwall	1.25	28.13	35.16	0.75	26.37
Stem	1.25	724.03	905.03	2.04	1847.78
Stem 2	1.25	0.00	0.00	0.00	0.00
Concrete Footing	1.25	409.30	511.63	0.00	0.00
Vertical Soil 1	1.35	0.00	0.00	0.00	0.00
Vertical Soil 2	1.35	1239.60	1673.47	-3.50	-5857.13
Approach Slab (DC)	1.25	20.00	25.00	-5.00	-125.00
Superstructure Dead (DC)	1.25	169.90	212.38	2.75	584.03
Wearing Surface (DW)	1.50	26.10	39.15	2.75	107.66
Live from Superstructure (LL)	1.35		0.00	2.75	0.00
Braking Force (BRV)	1.35		0.00	2.75	0.00
Wind from Superstructure, WSV	1.00	0.00	0.00	2.75	0.00
Wind from Vehicle, WLW	1.00		0.00	2.75	0.00
Thermal Force, TU	0.50	0.00	0.00	2.75	0.00
P_{v1}	1.35	0.00	0.00	-7.00	0.00
P_{v2}	1.35	0.00	0.00	-7.00	0.00
P_{v3}	1.35	0.00	0.00	-7.00	0.00
P_{LSV}	1.35	0.00	0.00	-7.00	0.00
LS	1.35	0.00	0.00	-3.50	0.00
TOTAL		2617.06	3401.81		-3416.29

 ΣM_v

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project: Bridge No. W-38-003	Job No.:		Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022	
Detail: STR III	Checked by: SS		Date: 6/2022	

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about CL Footing	Factored Moment
P_{h1}	1.35	1119.90	1511.86	10.00	15118.59
P_{h2}	1.35	0.00	0.00	0.00	0.00
P_{h3}	1.35	0.00	0.00	0.00	0.00
P_{LSH}	1.35	0.00	0.00	15.00	0.00
Braking Force (BRH)	1.35		0.00	27.27	0.00
Wind from Superstructure, WSH	1.00	0.30	0.30	27.27	8.18
Wind from Vehicle, WLH	1.00		0.00	27.27	0.00
Thermal Force, TU	1.00	12.70	12.70	27.27	346.33
TOTAL		1132.90	1524.86		15473.10

 ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_STR III	Checked by: FL	Date: 6/2022	

Pile STR III

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, F_z = **3401.81 kips**

F_y = **1524.86 kips**

F_x = **8.00 kips**

M_x = **12056.81 k-ft**

M_y = **190.00 kips-ft**

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	$\frac{M_x(Y_i - Y_{C.G.})}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_i - X_{C.G.})}{\sum (X_i - X_{C.G.})^2}$	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-84.31	-0.52	87.226	2.39	39.10	0.21
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-84.31	-0.43	87.226	2.48	39.10	0.21
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-84.31	-0.35	87.226	2.56	39.10	0.21
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-84.31	-0.26	87.226	2.65	39.10	0.21
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-84.31	-0.17	87.226	2.74	39.10	0.21
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-84.31	-0.09	87.226	2.83	39.10	0.21
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-84.31	0.00	87.226	2.91	39.10	0.21
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-84.31	0.09	87.226	3.00	39.10	0.21
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-84.31	0.17	87.226	3.09	39.10	0.21
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-84.31	0.26	87.226	3.17	39.10	0.21
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-84.31	0.35	87.226	3.26	39.10	0.21
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-84.31	0.43	87.226	3.35	39.10	0.21
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-84.31	0.52	87.226	3.43	39.10	0.21
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-0.52	87.226	86.70	39.10	0.21
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-0.43	87.226	86.79	39.10	0.21
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-0.35	87.226	86.88	39.10	0.21
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.26	87.226	86.96	39.10	0.21
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.17	87.226	87.05	39.10	0.21
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.09	87.226	87.14	39.10	0.21
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	87.226	87.23	39.10	0.21
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.09	87.226	87.31	39.10	0.21
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.17	87.226	87.40	39.10	0.21
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.26	87.226	87.49	39.10	0.21
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	0.35	87.226	87.57	39.10	0.21
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	0.43	87.226	87.66	39.10	0.21
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	0.52	87.226	87.75	39.10	0.21
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	84.31	-0.52	87.226	171.02	39.10	0.21
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	84.31	-0.43	87.226	171.10	39.10	0.21
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	84.31	-0.35	87.226	171.19	39.10	0.21
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	84.31	-0.26	87.226	171.28	39.10	0.21
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	84.31	-0.17	87.226	171.37	39.10	0.21
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	84.31	-0.09	87.226	171.45	39.10	0.21
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	84.31	0.00	87.226	171.54	39.10	0.21
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	84.31	0.09	87.226	171.63	39.10	0.21
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	84.31	0.17	87.226	171.71	39.10	0.21
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	84.31	0.26	87.226	171.80	39.10	0.21
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	84.31	0.35	87.226	171.89	39.10	0.21
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	84.31	0.43	87.226	171.97	39.10	0.21
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	84.31	0.52	87.226	172.06	39.10	0.21
	24.58			0.00	0.00						172.06	39.10	0.21

$$X_{C.G.} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (39.10^2 + 0.21^2)^{0.5} = 39.10 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail: STR V	Checked by: SS		Date: 6/2022

Summary of Factored Loads - STR V: 1.25DC + 1.35EH + 1.35EV + 1.35 (LS+LL+BR) + WS + WL + 0.5 TU

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⌒ Footing	Factored Moment
Backwall	1.25	28.13	35.16	0.75	26.37
Stem	1.25	724.03	905.03	2.04	1847.78
Stem 2	1.25	0.00	0.00	0.00	0.00
Concrete Footing	1.25	409.30	511.63	0.00	0.00
Vertical Soil 1	1.35	0.00	0.00	0.00	0.00
Vertical Soil 2	1.35	1239.60	1673.47	-3.50	-5857.13
Approach Slab (DC)	1.25	20.00	25.00	-5.00	-125.00
Superstructure Dead (DC)	1.25	169.90	212.38	2.75	584.03
Wearing Surface (DW)	1.50	26.10	39.15	2.75	107.66
Live from Superstructure (LL)	1.35	136.40	184.14	2.75	506.39
Braking Force (BRV)	1.35	3.90	5.27	2.75	14.48
Wind from Superstructure, WSV	0.40	0.00	0.00	2.75	0.00
Wind from Vehicle, WLW	1.00	0.30	0.30	2.75	0.83
Thermal Force, TU	0.50	0.00	0.00	2.75	0.00
P_{v1}	1.35	0.00	0.00	-7.00	0.00
P_{v2}	1.35	0.00	0.00	-7.00	0.00
P_{v3}	1.35	0.00	0.00	-7.00	0.00
P_{LSV}	1.35	0.00	0.00	-7.00	0.00
LS	1.35	0.00	0.00	-3.50	0.00
TOTAL		2757.66	3591.51		-2894.60

ΣM_v

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project:	Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject:	Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail:	STR V	Checked by: SS		Date: 6/2022

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about CL Footing	Factored Moment
P_{h1}	1.35	1119.90	1511.86	10.00	15118.59
P_{h2}	1.35	0.00	0.00	0.00	0.00
P_{h3}	1.35	0.00	0.00	0.00	0.00
P_{LSH}	1.35	0.00	0.00	15.00	0.00
Braking Force (BRH)	1.35	17.60	23.76	27.27	647.94
Wind from Superstructure, WSH	0.40	0.30	0.12	27.27	3.27
Wind from Vehicle, WLH	1.00	1.20	1.20	27.27	32.72
Thermal Force, TU	1.00	12.70	12.70	27.27	346.33
TOTAL		1151.70	1549.64		16148.85

 ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_STR V	Checked by: FL	Date: 6/2022	

Pile STR V

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, F_z = **3591.51 kips**

F_y = **1549.64 kips**

F_x = **11.00 kips**

M_x = **13254.25 k-ft**

M_y = **292.00 kips-ft**

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	M _x (Y _i - Y _{C.G.}) Σ (Y _i - Y _{C.G.}) ²	M _y (X _i - X _{C.G.}) Σ (X _i - X _{C.G.}) ²	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-92.69	-0.80	92.090	-1.40	39.73	0.28
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-92.69	-0.67	92.090	-1.27	39.73	0.28
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-92.69	-0.53	92.090	-1.13	39.73	0.28
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-92.69	-0.40	92.090	-1.00	39.73	0.28
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-92.69	-0.27	92.090	-0.86	39.73	0.28
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-92.69	-0.13	92.090	-0.73	39.73	0.28
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-92.69	0.00	92.090	-0.60	39.73	0.28
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-92.69	0.13	92.090	-0.46	39.73	0.28
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-92.69	0.27	92.090	-0.33	39.73	0.28
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-92.69	0.40	92.090	-0.20	39.73	0.28
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-92.69	0.53	92.090	-0.06	39.73	0.28
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-92.69	0.67	92.090	0.07	39.73	0.28
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-92.69	0.80	92.090	0.21	39.73	0.28
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-0.80	92.090	91.29	39.73	0.28
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-0.67	92.090	91.42	39.73	0.28
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-0.53	92.090	91.56	39.73	0.28
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.40	92.090	91.69	39.73	0.28
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.27	92.090	91.82	39.73	0.28
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.13	92.090	91.96	39.73	0.28
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	92.090	92.09	39.73	0.28
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.13	92.090	92.22	39.73	0.28
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.27	92.090	92.36	39.73	0.28
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.40	92.090	92.49	39.73	0.28
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	0.53	92.090	92.62	39.73	0.28
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	0.67	92.090	92.76	39.73	0.28
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	0.80	92.090	92.89	39.73	0.28
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	92.69	-0.80	92.090	183.97	39.73	0.28
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	92.69	-0.67	92.090	184.11	39.73	0.28
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	92.69	-0.53	92.090	184.24	39.73	0.28
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	92.69	-0.40	92.090	184.38	39.73	0.28
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	92.69	-0.27	92.090	184.51	39.73	0.28
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	92.69	-0.13	92.090	184.64	39.73	0.28
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	92.69	0.00	92.090	184.78	39.73	0.28
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	92.69	0.13	92.090	184.91	39.73	0.28
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	92.69	0.27	92.090	185.04	39.73	0.28
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	92.69	0.40	92.090	185.18	39.73	0.28
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	92.69	0.53	92.090	185.31	39.73	0.28
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	92.69	0.67	92.090	185.45	39.73	0.28
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	92.69	0.80	92.090	185.58	39.73	0.28
	24.58			0.00	0.00						185.58	39.73	0.28

$$X_{C.G.} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (39.73^2 + 0.28^2)^{0.5} = 39.74 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail: Service I for Settlement	Checked by: SS		Date: 6/2022

Summary of Factored Loads - Service I: 1.0DC + 1.0EH + 1.0EV + 0.3WS + WL + 1.2TUVertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (kips)	Factored vertical load, V_u (kips)	Arm about ⊥ Footing	Factored Moment
Backwall	1.00	28.13	28.13	0.75	21.09
Stem	1.00	724.03	724.03	2.04	1478.22
Stem 2	1.00	0.00	0.00	0.00	0.00
Concrete Footing	1.00	409.30	409.30	0.00	0.00
Vertical Soil 1	1.00	0.00	0.00	0.00	0.00
Vertical Soil 2	1.00	1239.60	1239.60	-3.50	-4338.61
Approach Slab (DC)	1.00	20.00	20.00	-5.00	-100.00
Superstructure Dead (DC)	1.00	169.90	169.90	2.75	467.23
Wearing Surface (DW)	1.00	26.10	26.10	2.75	71.78
Live from Superstructure (LL)	1.00	136.40	136.40	2.75	375.10
Braking Force (BRV)	1.00	3.90	3.90	2.75	10.73
Wind from Superstructure, WSV	0.30	0.00	0.00	2.75	0.00
Wind from Vehicle, WLV	1.00	0.30	0.30	2.75	0.83
Thermal Force, TU	1.00	0.00	0.00	2.75	0.00
P_{v1}	1.00	0.00	0.00	-7.00	0.00
P_{v2}	1.00	0.00	0.00	-7.00	0.00
P_{v3}	1.00	0.00	0.00	-7.00	0.00
P_{LSV}	1.00	0.00	0.00	-7.00	0.00
LS	1.00	0.00	0.00	-3.50	0.00
TOTAL		2757.66	2757.66		-2013.65

 ΣM_v

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: FL		Date: 6/2022
Detail: Service I for Settlement	Checked by: SS		Date: 6/2022

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (kips)	Factored horizontal load, H_u (kip)	Arm about CL Footing	Factored Moment
P_{h1}	1.00	1119.90	1119.90	10.00	11198.95
P_{h2}	1.00	0.00	0.00	0.00	0.00
P_{h3}	1.00	0.00	0.00	0.00	0.00
P_{LSH}	1.00	0.00	0.00	15.00	0.00
Braking Force (BRH)	1.00	17.60	17.60	27.27	479.95
Wind from Superstructure, WSH	0.30	0.30	0.09	27.27	2.45
Wind from Vehicle, WLH	1.00	1.20	1.20	27.27	32.72
Thermal Force, TU	1.20	12.70	15.24	27.27	415.59
TOTAL		1151.70	1154.03		12129.68

ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Abutment - 10.75 Dia Micropile	Prepared by: SS	Date: 6/2022	
Detail: Pile_SER I	Checked by: FL	Date: 6/2022	

Pile SER I

Cross Section = **0.63 ft.²**

Number of Pile, n = 39

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Vertical, $F_z = 2757.66$ kips

$F_y = 1154.03$ kips

$F_x = 10.00$ kips

$M_x = 10116.03$ k-ft

$M_y = 250.00$ kips-ft

Pile #	A_p (sf)	X_i (ft.)	Y_i (ft.)	$A_p X_i$ (ft. ³)	$A_p Y_i$ (ft. ³)	dx^2 ($X_i - X_{C.G.}$) ²	dy^2 ($Y_i - Y_{C.G.}$) ²	$\frac{M_x(Y_i - Y_{C.G.})}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_i - X_{C.G.})}{\sum (X_i - X_{C.G.})^2}$	F_z / n	$\sum F_z$ (kips)	Shear F_y / n	Shear F_x / n
1	0.63	-24.0000	-5.5000	-15.127	-3.467	576.000	30.250	-70.74	-0.69	70.709	-0.72	29.59	0.26
2	0.63	-20.0000	-5.5000	-12.606	-3.467	400.000	30.250	-70.74	-0.57	70.709	-0.60	29.59	0.26
3	0.63	-16.0000	-5.5000	-10.085	-3.467	256.000	30.250	-70.74	-0.46	70.709	-0.49	29.59	0.26
4	0.63	-12.0000	-5.5000	-7.564	-3.467	144.000	30.250	-70.74	-0.34	70.709	-0.38	29.59	0.26
5	0.63	-8.0000	-5.5000	-5.042	-3.467	64.000	30.250	-70.74	-0.23	70.709	-0.26	29.59	0.26
6	0.63	-4.0000	-5.5000	-2.521	-3.467	16.000	30.250	-70.74	-0.11	70.709	-0.15	29.59	0.26
7	0.63	0.0000	-5.5000	0.000	-3.467	0.000	30.250	-70.74	0.00	70.709	-0.03	29.59	0.26
8	0.63	4.0000	-5.5000	2.521	-3.467	16.000	30.250	-70.74	0.11	70.709	0.08	29.59	0.26
9	0.63	8.0000	-5.5000	5.042	-3.467	64.000	30.250	-70.74	0.23	70.709	0.20	29.59	0.26
10	0.63	12.0000	-5.5000	7.564	-3.467	144.000	30.250	-70.74	0.34	70.709	0.31	29.59	0.26
11	0.63	16.0000	-5.5000	10.085	-3.467	256.000	30.250	-70.74	0.46	70.709	0.43	29.59	0.26
12	0.63	20.0000	-5.5000	12.606	-3.467	400.000	30.250	-70.74	0.57	70.709	0.54	29.59	0.26
13	0.63	24.0000	-5.5000	15.127	-3.467	576.000	30.250	-70.74	0.69	70.709	0.65	29.59	0.26
14	0.63	-24.0000	0.0000	-15.127	0.000	576.000	0.000	0.00	-0.69	70.709	70.02	29.59	0.26
15	0.63	-20.0000	0.0000	-12.606	0.000	400.000	0.000	0.00	-0.57	70.709	70.14	29.59	0.26
16	0.63	-16.0000	0.0000	-10.085	0.000	256.000	0.000	0.00	-0.46	70.709	70.25	29.59	0.26
17	0.63	-12.0000	0.0000	-7.564	0.000	144.000	0.000	0.00	-0.34	70.709	70.37	29.59	0.26
18	0.63	-8.0000	0.0000	-5.042	0.000	64.000	0.000	0.00	-0.23	70.709	70.48	29.59	0.26
19	0.63	-4.0000	0.0000	-2.521	0.000	16.000	0.000	0.00	-0.11	70.709	70.59	29.59	0.26
20	0.63	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.00	70.709	70.71	29.59	0.26
21	0.63	4.0000	0.0000	2.521	0.000	16.000	0.000	0.00	0.11	70.709	70.82	29.59	0.26
22	0.63	8.0000	0.0000	5.042	0.000	64.000	0.000	0.00	0.23	70.709	70.94	29.59	0.26
23	0.63	12.0000	0.0000	7.564	0.000	144.000	0.000	0.00	0.34	70.709	71.05	29.59	0.26
24	0.63	16.0000	0.0000	10.085	0.000	256.000	0.000	0.00	0.46	70.709	71.17	29.59	0.26
25	0.63	20.0000	0.0000	12.606	0.000	400.000	0.000	0.00	0.57	70.709	71.28	29.59	0.26
26	0.63	24.0000	0.0000	15.127	0.000	576.000	0.000	0.00	0.69	70.709	71.40	29.59	0.26
27	0.63	-24.0000	5.5000	-15.127	3.467	576.000	30.250	70.74	-0.69	70.709	140.76	29.59	0.26
28	0.63	-20.0000	5.5000	-12.606	3.467	400.000	30.250	70.74	-0.57	70.709	140.88	29.59	0.26
29	0.63	-16.0000	5.5000	-10.085	3.467	256.000	30.250	70.74	-0.46	70.709	140.99	29.59	0.26
30	0.63	-12.0000	5.5000	-7.564	3.467	144.000	30.250	70.74	-0.34	70.709	141.11	29.59	0.26
31	0.63	-8.0000	5.5000	-5.042	3.467	64.000	30.250	70.74	-0.23	70.709	141.22	29.59	0.26
32	0.63	-4.0000	5.5000	-2.521	3.467	16.000	30.250	70.74	-0.11	70.709	141.34	29.59	0.26
33	0.63	0.0000	5.5000	0.000	3.467	0.000	30.250	70.74	0.00	70.709	141.45	29.59	0.26
34	0.63	4.0000	5.5000	2.521	3.467	16.000	30.250	70.74	0.11	70.709	141.57	29.59	0.26
35	0.63	8.0000	5.5000	5.042	3.467	64.000	30.250	70.74	0.23	70.709	141.68	29.59	0.26
36	0.63	12.0000	5.5000	7.564	3.467	144.000	30.250	70.74	0.34	70.709	141.79	29.59	0.26
37	0.63	16.0000	5.5000	10.085	3.467	256.000	30.250	70.74	0.46	70.709	141.91	29.59	0.26
38	0.63	20.0000	5.5000	12.606	3.467	400.000	30.250	70.74	0.57	70.709	142.02	29.59	0.26
39	0.63	24.0000	5.5000	15.127	3.467	576.000	30.250	70.74	0.69	70.709	142.14	29.59	0.26
	24.58			0.00	0.00						142.14	29.59	0.26

$$X_{C.G.} = \frac{\sum A_p X_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$Y_{C.G.} = \frac{\sum A_p Y_i}{\sum A_p} = 0.00 / 24.58 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 8736.00 \text{ ft.}^2$$

$$\sum (Y_i - Y_{C.G.})^2 = 786.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (29.59^2 + 0.26^2)^{0.5} = 29.59 \text{ kips}$$

LAMSON ENGINEERING CORPORATION			Final Page No:
Project:	Bridge No. W-38-003, Wilmington	Job No:	Preliminary Sheet No:
Subject:	Abutment 10.75 Dia.Micropile Foundation	Prepared by: SS	Date: 6/2022
Detail:	Micropile Vertical Resistance	Checked by: FL	Date: 6/2022

Axial Compression Resistance

Based on Boring BB-1 $O.D. = 10.75$ in. $t_{wall} = 0.595$ in.

$$R_R = \text{Factored Resistance of a micropile}$$

$$= \phi R_n = \phi_{qp} R_p + \phi_{qs} R_s$$

in which:

$$R_p = q_p A_p$$

$$R_s = q_s A_s$$

where:

$$R_p = \text{nominal tip resistance}$$

(Per AASHTO C10.9.3.5.1, tip resistance is neglected for conservative)

$$R_s = \text{nominal grout to ground bond resistance}$$

$$\phi_{qp} = \text{resistance factor for tip resistance}$$

$$= 0.50 \quad (\text{Note: no tip resistance}) \quad (\text{AASHTO 10.5.5.2.5-1})$$

$$\phi_{qs} = \text{resistance factor for grout-to-ground resistance}$$

$$= 0.55 \quad (\text{AASHTO 10.5.5.2.5-1})$$

$$d_p = \text{diameter of micropile tip}$$

$$= 9.56 \text{ in.}$$

$$A_p = \text{area of micropile tip} = \pi D^2/4$$

$$= 71.78 \text{ in.}^2 = 0.50 \text{ ft}^2$$

$$R_s = \pi d_b \alpha_b L_b$$

in which:

$$d_b = \text{diameter of micropile drill hole through bonded length}$$

$$= 9.56 \text{ in.} = 0.80 \text{ ft}$$

$$\alpha_b = \text{nominal micropile grout-to-ground bond strength}$$

$$= 21.6 \text{ ksf for Type A Diorite}$$

(AASHTO Table C10.9.3.5.2 - 1)

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$$L_b = \text{micropile bonded length}$$

$$= 7 \text{ ft into Rock}$$

$$\phi_{qs} R_s = 0.55 \times 3.141 \times 0.8 \times [21.6 \times 7]$$

$$= 208.1 \text{ kips}$$

$$R_n = 208.13 / 0.55 = \underline{378 \text{ kips}}$$

$$R_R = \underline{208 \text{ kips}}$$

Uplift Resistance

$$\text{Uplift Resistance} = 50 \% \text{ of the compression resistance}$$

$$= 0.5 \times 208.1 = \underline{104 \text{ kips}}$$

$$\phi_{up} = \text{resistance factor}$$

$$= 0.55$$

$$\text{Nominal Resistance} = 104.1 / 0.55 = \underline{189 \text{ kips}}$$

Structural Resistance

Axial Compression Resistance

$$R_C = \text{Factored Structural Resistance of a micropile}$$

$$= \phi_c R_n$$

in which:

$$\phi_C = \text{resistance factor for tip resistance}$$

$$= 0.75 \quad (\text{AASHTO 10.5.5.2.5-2})$$

$$R_n = \text{Nominal axial compression resistance}$$

• For the cased length

$$F_y = 52 \text{ ksi}$$

$$f_y = 60 \text{ ksi} \quad (\text{Reinforcing Bar Grade 60})$$

$$R_n = 0.85 [0.85 f'_c A_g + f_y (A_b + A'_c)]$$

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Detail:	Micropile Vertical Resistance	Checked by:	FL	Date: 6/2022

where:

$$\begin{aligned} f'_c &= \text{specified compressive strength of micropile grout at 28 days} \\ &= 5.0 \text{ ksi} \end{aligned}$$

$$\begin{aligned} f_y &= \text{specified minimum yield strength of reinforcement bar or steel casing,} \\ &\text{or stress in steel reinforcement bar or casing at a strain of 0.003,} \\ &\text{whichever is less} \end{aligned}$$

$$\text{Min. } (F_y, f_y) = 52.0 \text{ ksi}$$

$$d_b = 1.69 \text{ in. } \#14 \text{ threaded bar}$$

$$\begin{aligned} A_b &= \text{cross-section area of steel reinforcing bar} \\ &= 2.25 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} A_c &= \text{cross-section area of steel casing} \\ &= 18.98 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} A'_c &= \text{cross-section area of steel casing with 1/16" section loss on outside of the casing} \\ &= 16.9 \text{ in.}^2 \quad \text{Section loss} = 0.063 \text{ in.} \end{aligned}$$

$$\begin{aligned} A_{cTJ} &= \text{cross-section area of steel casing at thread join with 50% of wall thickness} \\ &= 9.21 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} A_g &= \text{cross-section area of grout within micropile} \\ &= A_{ID} - A_b = 71.78 - 2.25 \\ &= 69.53 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} R_n &= 0.85 \times [0.85 \times 5 \times 69.53 + 52 \times (2.25 + 16.88)] \\ &= 1096.9 \text{ kips} \end{aligned}$$

$$R_{CC} = 0.75 \times 1096.9 = \underline{\underline{823 \text{ kips}}}$$

• For the uncased length

$$R_n = 0.85 [0.85 f'_c A_g + f_y A_b]$$

$$\begin{aligned} f_y &= \text{specified minimum yield strength of reinforcement bar} \\ &\text{or stress in steel reinforcement bar at a strain of 0.003, whichever is less} \\ &= 60.0 \text{ ksi} \end{aligned}$$

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$$= 60 \text{ ksi}$$

$$R_n = 0.85 \times [0.85 \times 5 \times 69.53 + 60 \times 2.25]$$

$$= 366.0 \text{ kips}$$

$$R_{CU} = 0.75 \times 366 = \underline{274 \text{ kips}}$$

Axial Tension Resistance

$$R_T = \text{factored Structural Resistance of a micropile}$$

$$= \phi_T R_n$$

in which:

$$\phi_T = \text{resistance factor for tip resistance}$$

$$= 0.80 \quad (\text{AASHTO 10.5.5.2.5-2})$$

$$R_n = \text{nominal axial tension resistance}$$

• For the cased length

$$R_n = f_y (A_b + A'_c)$$

$$= 52 \times (2.25 + 16.88) = 995.0 \text{ kips}$$

$$R_{TC} = 0.8 \times 995 = \underline{796 \text{ kips}}$$

Thread Joint, Consider wall thickness to reduced by 50%

$$R_n = f_y (A_b + A_{cTJ})$$

$$= 52 \times (2.25 + 9.21) = 596.1 \text{ kips}$$

$$R_{TC} = 0.8 \times 596.1 = \underline{477 \text{ kips}}$$

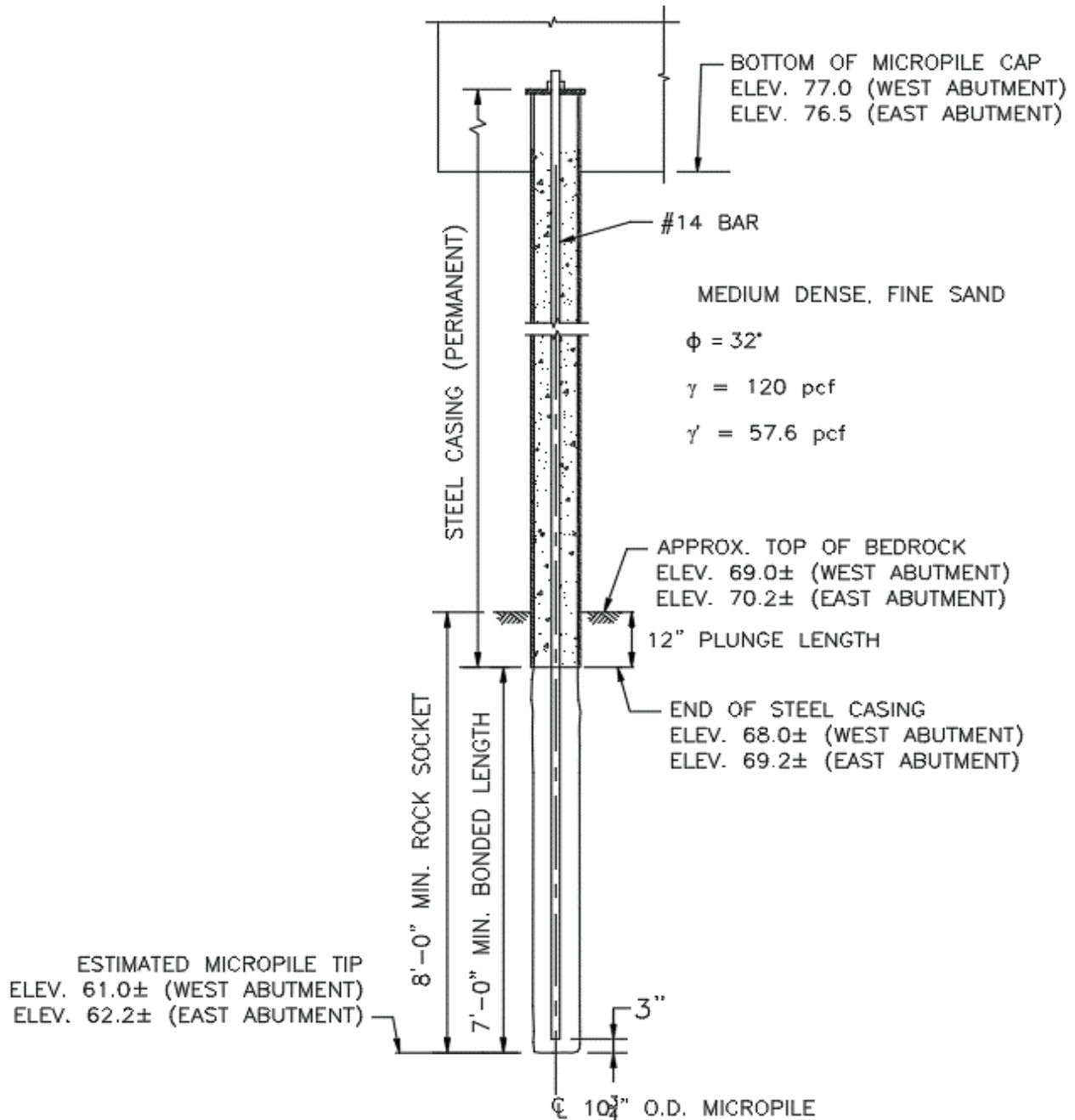
• For the uncased length

$$R_n = f_y A_b$$

$$= 60 \times 2.25 = 135.1 \text{ kips}$$

$$R_{TU} = 0.8 \times 135.1 = \underline{108 \text{ kips}}$$

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Subject:	Abutment 10.75 Dia. Micropile Foundation	Prepared by: SS	Date: 6/2022
Detail:	Lpile Analysis	Checked by: FL	Date: 6/2022



LAMSON ENGINEERING CORPORATION		Final Page No:	
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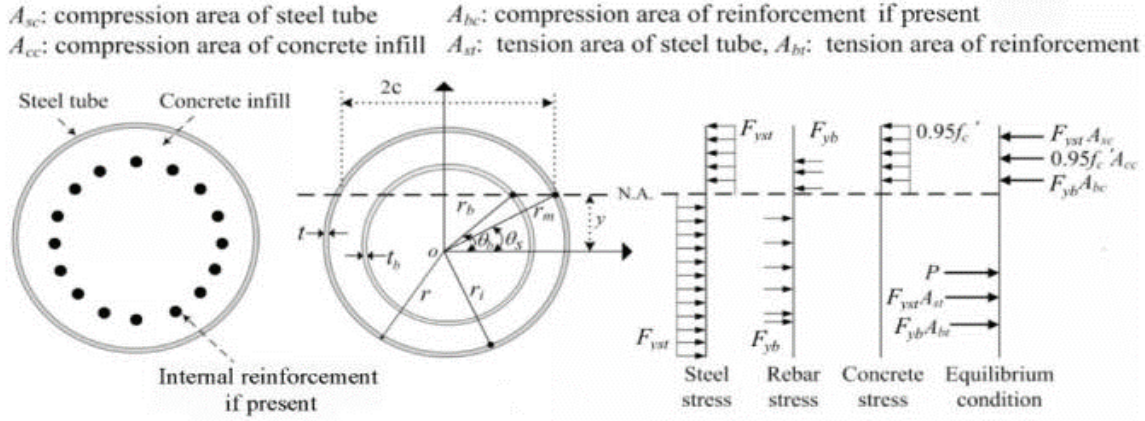


Figure C6.12.2.3.3-1—PSDM Model

$$\begin{aligned}
 P_n = & F_{yt} t r_m \left[(\pi - 2\theta_s) - (\pi + 2\theta_s) \right] \\
 & + t_b r_b \left[F_{yb} (\pi - 2\theta_b) - (F_{yb} - 0.95 f'_c) (\pi + 2\theta_b) \right] \\
 & + \frac{0.95 f'_c}{2} \left[(\pi - 2\theta_s) r_i^2 - 2yc \right]
 \end{aligned}
 \tag{C6.12.2.3.3-1}$$

$$\begin{aligned}
 M_n = & 0.95 f'_c c \left[(r_i^2 - y^2) - \frac{c^2}{3} \right] + 4 F_{yt} t c \frac{r_m^2}{r_i} + 4 F_{yb} t_b c_b r_b \\
 & - 4 F_{yb} t_b c_b r_b
 \end{aligned}
 \tag{C6.12.2.3.3-2}$$

in which:

$$r_m = r - \frac{t}{2} \tag{C6.12.2.3.3-3}$$

$$\theta_s = \sin^{-1} \left(\frac{y}{r_m} \right) \tag{C6.12.2.3.3-4}$$

$$\theta_b = \sin^{-1} \left(\frac{y}{r_b} \right) \tag{C6.12.2.3.3-5}$$

$$c = r_i \cos \theta_s \tag{C6.12.2.3.3-6}$$

$$c_b = r_b \cos \theta_b \tag{C6.12.2.3.3-7}$$

$$t_b = \frac{n A_b}{2 \pi r_b} \tag{C6.12.2.3.3-8}$$

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Yield Strength, $F_{yst} = 52.00$ ksi
 Strength of Concrete, $f'_c = 5.00$ ksi
 Resistance factor for CFST in compression, $\phi_c = 0.90$ (AASHTO 6.5.4.2)
 Yield Strength, $F_{yb} = 60.00$ ksi
 (AASHTO 6.9.6.2 Limitations) $D/t = 20.0 < 0.15 E / F_{yst} = 83.7$ **OK**
 Concrete shall be greater than 3 ksi or $0.075 F_{yst} = 3.9$ ksi < 5.00 ksi **OK**

$A_s = 2.25$ in² Cover = 3.934 in.
 $r = 5.313$ in. $t = 0.5325$ in.
 $r_m = 5.046$ in.
 $r_i = 4.780$ in.
 $r_b = 0.000$ in. Internal reinforcement is not considered.
 Number of reinforcing bars, $n = 1.0$
 $t_b = n A_s / (2 \pi r_b) = 0$ in.

Strength I

Factored Moment = 167.4 k-ft from Lpile
 Factored Axial Load = 186.6 k from Lpile

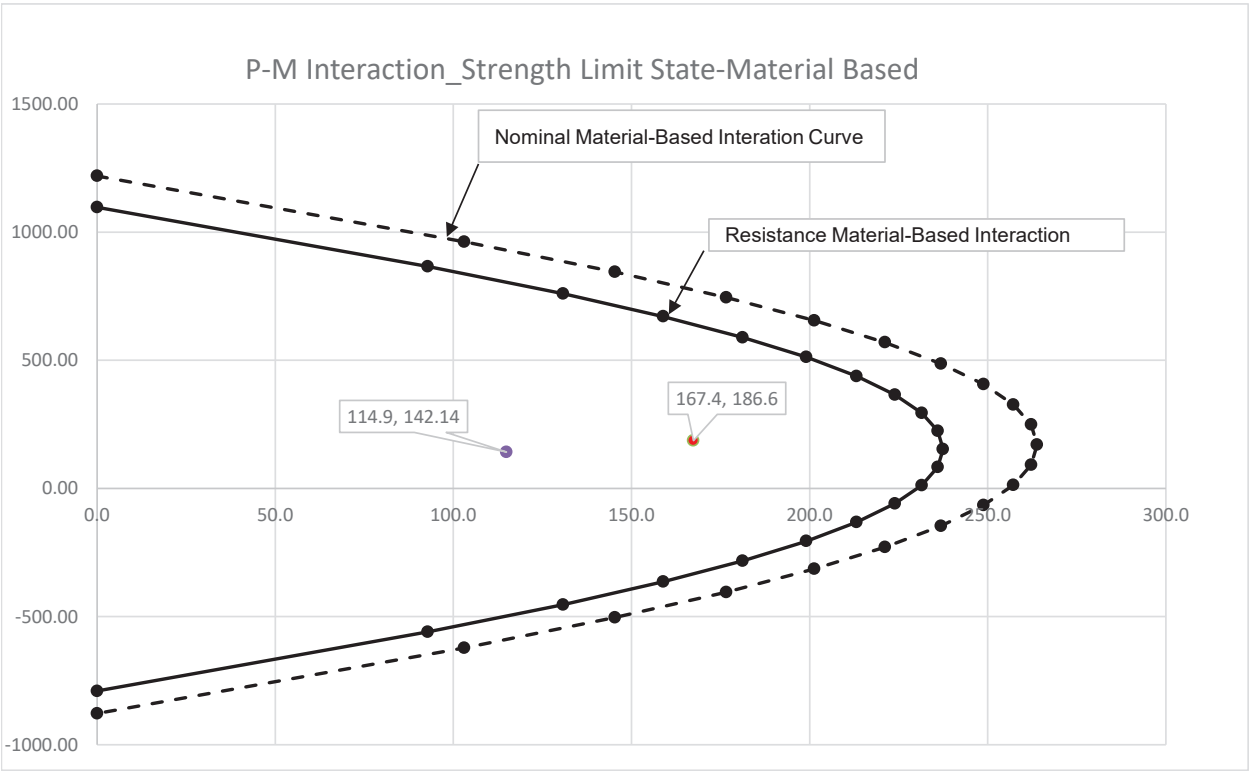
Service I

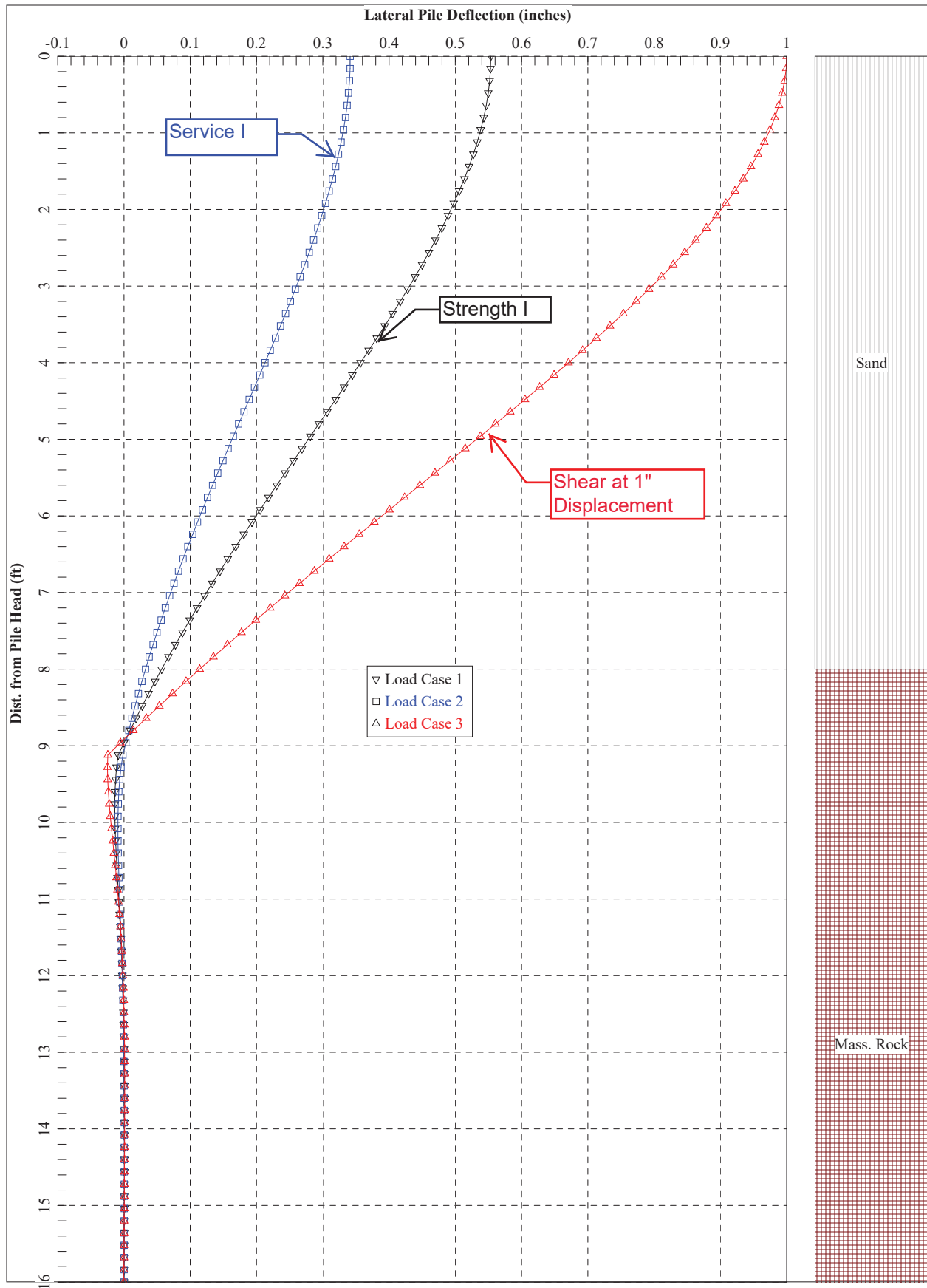
Factored Moment = 114.9 k-ft from Lpile
 Factored Axial Load = 142.14 k from Lpile

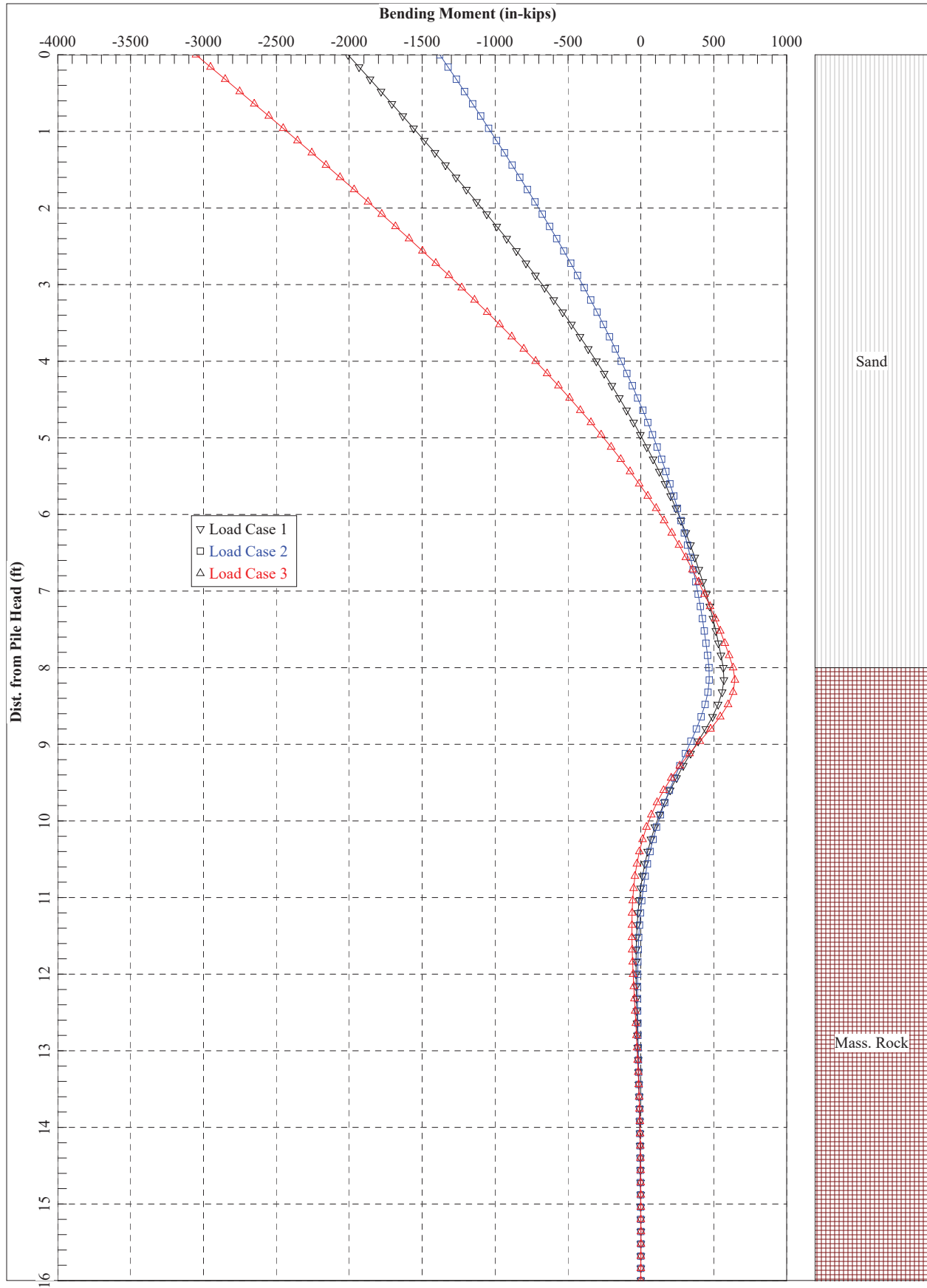
Composite Concrete-Filled Steel Tubes (CFSTs) (AASHTO LRFD 6.12.2.3.3)

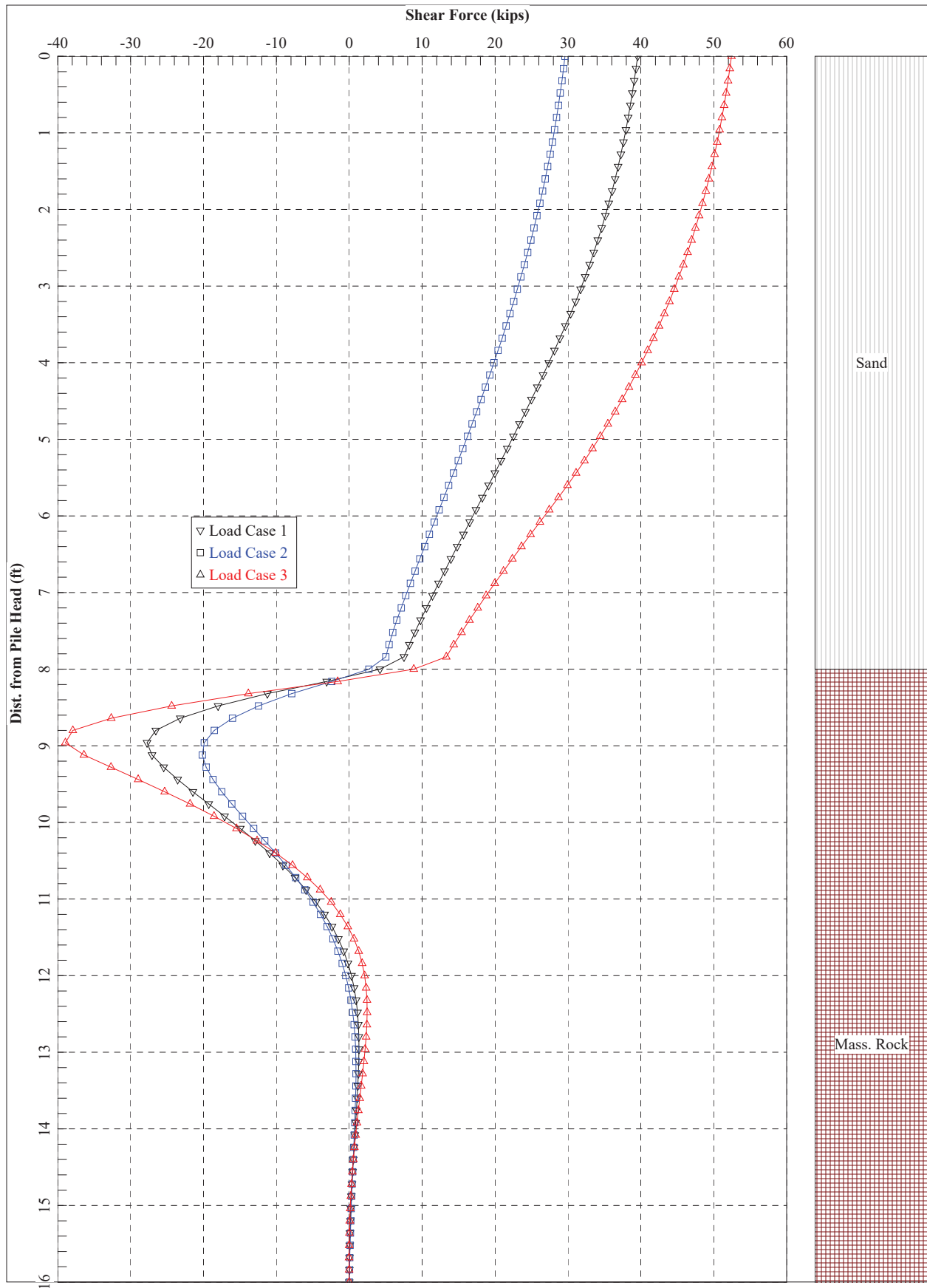
y (in.)	θ_s (rad)	θ_b (rad)	$c = r_i \cos \theta_b$	$c_b = r_b \cos \theta_b$	$\pi - 2 \theta_s$	$\pi + 2 \theta_s$	M_n (kips-ft)	P_n (kips)	$\phi_c M_n$ (kips-ft)	$\phi_c P_n$ (kips)
-5.05	-1.57	-1.57	0.00	0.00	6.28	0.00	0.00	1218.91	0.00	1097.02
-4.54	-1.12	-1.57	2.08	0.00	5.38	0.90	103.09	962.82	92.78	866.54
-4.04	-0.93	-1.57	2.87	0.00	5.00	1.29	145.35	844.40	130.81	759.96
-3.53	-0.78	-1.57	3.41	0.00	4.69	1.59	176.62	745.30	158.95	670.77
-3.03	-0.64	-1.57	3.82	0.00	4.43	1.85	201.36	654.98	181.23	589.48
-2.52	-0.52	-1.57	4.14	0.00	4.19	2.09	221.20	569.57	199.08	512.61
-2.02	-0.41	-1.57	4.38	0.00	3.96	2.32	236.88	487.15	213.19	438.44
-1.51	-0.30	-1.57	4.56	0.00	3.75	2.53	248.81	406.64	223.93	365.97
-1.01	-0.20	-1.57	4.68	0.00	3.54	2.74	257.20	327.33	231.48	294.59
-0.50	-0.10	-1.57	4.76	0.00	3.34	2.94	262.20	248.74	235.98	223.86
0.00	0.00	1.57	4.78	0.00	3.14	3.14	263.86	170.48	237.47	153.43
0.50	0.10	1.57	4.76	0.00	2.94	3.34	262.20	92.22	235.98	83.00
1.01	0.20	1.57	4.68	0.00	2.74	3.54	257.20	13.63	231.48	12.27
1.51	0.30	1.57	4.56	0.00	2.53	3.75	248.81	-65.68	223.93	-59.11
2.02	0.41	1.57	4.38	0.00	2.32	3.96	236.88	-146.19	213.19	-131.57
2.52	0.52	1.57	4.14	0.00	2.09	4.19	221.20	-228.61	199.08	-205.75
3.03	0.64	1.57	3.82	0.00	1.85	4.43	201.36	-314.02	181.23	-282.62
3.53	0.78	1.57	3.41	0.00	1.59	4.69	176.62	-404.34	158.95	-363.90
4.04	0.93	1.57	2.87	0.00	1.29	5.00	145.35	-503.44	130.81	-453.10
4.54	1.12	1.57	2.08	0.00	0.90	5.38	103.09	-621.86	92.78	-559.68
5.05	1.57	1.57	0.00	0.00	0.00	6.28	0.00	-877.95	0.00	-790.16

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LPILE for Windows, Version 2022-12.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:
\\Users\\Lamson Engineering\\Desktop\\Charlie's Lamson Files\\GIA\\W-38-003 (2NV) - Wilmington\\5.1 Geotech Report -
Updated loads\\LPILE\\

Name of input data file:
Wilmington W38003_West Abutment Micropile.lp12d

Name of output report file:
Wilmington W38003_West Abutment Micropile.lp12o

Name of plot output file:
Wilmington W38003_West Abutment Micropile.lp12p

Name of runtime message file:
Wilmington W38003_West Abutment Micropile.lp12r

Date and Time of Analysis

Date: June 19, 2022

Time: 11:09:52

Problem Title

Butters Row Bridge W-38-003, Wilmington

Job Number:

Client: MassDOT

Engineer: Lamson Engineering Corporation

Description: West Abutment Micropile

Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Cyclic loading specified
- Number of cycles of loading = 2 cycles
- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

- Number of pile sections defined = 2
- Total length of pile = 16.000 ft
- Depth of ground surface below top of pile = -3.5000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	10.7500
2	9.000	10.7500
3	9.000	9.5600

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with permanent casing
Length of section = 9.000000 ft
Casing outside diameter = 10.750000 in

Pile Section No. 2:

Section 2 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	7.000000 ft
Shaft Diameter	=	9.560000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000 degrees
	=	0.000 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	-3.50000 ft
Distance from top of pile to bottom of layer	=	8.000000 ft
Effective unit weight at top of layer	=	57.600000 pcf
Effective unit weight at bottom of layer	=	57.600000 pcf
Friction angle at top of layer	=	32.000000 deg.
Friction angle at bottom of layer	=	32.000000 deg.
Subgrade k at top of layer	=	60.000000 pci
Subgrade k at bottom of layer	=	60.000000 pci

Layer 2 is massive rock, p-y criteria by Liang et al., 2009

Distance from top of pile to top of layer	=	8.000000	ft
Distance from top of pile to bottom of layer	=	20.500000	ft
Effective unit weight at top of layer	=	164.000000	pcf
Effective unit weight at bottom of layer	=	164.000000	pcf
Uniaxial compressive strength at top of layer	=	23836.	psi
Uniaxial compressive strength at bottom of layer	=	23836.	psi
Poisson's ratio at top of layer	=	0.090000	
Poisson's ratio at bottom of layer	=	0.090000	
Option 1: Intact rock modulus at top of layer	=	2480000.	psi
Intact rock modulus at bottom of layer	=	2480000.	psi
Option 1: Geologic Strength Index for layer	=	35.000000	
Option 2: Rock mass modulus at top of layer	=	0.0000	psi
Rock mass modulus at bottom of layer	=	0.0000	psi
Option 1 will be used to compute values of rock mass modulus for the p-y curve in massive rock.			
The rock type is (igneous) diorite, Hoek-Brown Material Constant m_i	=	25	

(Depth of the lowest soil layer extends 4.500 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 164.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Geologic Num. Strength Index	Soil Type Int. Rock Name Modulus (p-y Curve Type) psi	Hoek-Brown Material Index, mi	Layer Depth ft	Effective Unit Wt. Poisson's pcf Ratio	Angle of Friction deg.	Uniaxial qu psi	kpy pci	Rock Mass Modulus psi
1	Sand 0.00 (Reese, et al.) 0.00	0.00	-3.500 0.00 8.000 0.00	57.6000 0.00 57.6000 0.00	32.0000 32.0000	-- --	60.0000 60.0000	-- --
2	Massive 2480000. Rock 2480000.	25.0000	8.0000 0.09000 20.5000 0.09000	164.0000 0.09000 164.0000	-- --	23836. 23836.	-- --	Internally Computed

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.7000	1.0000
2	8.000	0.7000	1.0000

Cyclic Loading Type

Cyclic loading criteria were used for computation of p-y curves for all analyses.

Number of cycles of loading = 2

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
-------------	--------------	----------------	----------------	----------------------------	----------------------------------	--------------

1	2	V =	39560. lbs	S =	0.0000 in/in	186610.	Yes	Yes
2	2	V =	29590. lbs	S =	0.0000 in/in	142140.	Yes	Yes
3	5	y =	1.000000 in	S =	0.0000 in/in	142140.	N.A.	Yes

V = shear force applied normal to pile axis

M = bending moment applied to pile head

y = lateral deflection normal to pile axis

S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head

Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).

Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	9.000000 ft
Outer Diameter of Casing	=	10.750000 in
Concrete Cover Thickness Inside Casing	=	3.655000 in
Casing Wall Thickness	=	0.595000 in
Moment of Inertia of Steel Casing	=	245.530255 in^4
Yield Stress of Casing	=	52000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	1 bar
Area of Single Reinforcing Bar	=	2.250000 sq. in.
Edge-to-Edge Bar Spacing	=	-1.69300 in
Maximum Concrete Aggregate Size	=	0.375000 in
Ratio of Bar Spacing to Aggregate Size	=	-4.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Pile	=	90.762575 sq. in.
Area of Concrete	=	69.530366 sq. in.
Cross-sectional Area of Steel Casing	=	18.982210 sq. in.
Area of All Steel (Casing and Bars)	=	21.232210 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	23.39 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = $0.85 F_c A_c + F_y A_s$	=	1417.579 kips
Tensile Load for Cracking of Concrete	=	-103.016 kips
Nominal Axial Tensile Capacity	=	-1122.075 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	0.00000	0.00000

NOTE: The positions of the above rebars were computed by LPILE

Concrete Properties:

Compressive Strength of Concrete	=	5000. psi
Modulus of Elasticity of Concrete	=	4030509. psi
Modulus of Rupture of Concrete	=	-530.33009 psi
Compression Strain at Peak Stress	=	0.002109
Tensile Strain at Fracture of Concrete	=	-0.0001150
Maximum Coarse Aggregate Size	=	0.375000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
-----	-----
1	142.140
2	186.610

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 142.140 kips

Bending Max Casing Run Curvature Stress rad/in. ksi	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi
-----	-----	-----	-----	-----	-----	-----	-----
0.00000125	11.1701019	8936082.	127.1842871	0.0001590	0.0001455	0.7251401	4.4448132
4.6084820							
0.00000250	22.3384116	8935365.	66.2805742	0.0001657	0.0001388	0.7542641	4.4741073
4.8014448							
0.00000375	33.5067106	8935123.	45.9797530	0.0001724	0.0001321	0.7832953	4.5034466
4.9944528							
0.00000500	44.6749934	8934999.	35.8296547	0.0001791	0.0001254	0.8122337	4.5328312
5.1875062							
0.00000625	55.8432547	8934921.	29.7398456	0.0001859	0.0001187	0.8410793	4.5622611
5.3806049							
0.00000750	67.0114891	8934865.	25.6801811	0.0001926	0.0001120	0.8698318	4.5917363
5.5737488							
0.00000875	78.1796912	8934822.	22.7805993	0.0001993	0.0001053	0.8984914	4.6212568
5.7669380							
0.00001000	89.3478556	8934786.	20.6060690	0.0002061	0.00009856	0.9270578	4.6508225
5.9601725							
0.00001125	100.5159769	8934753.	18.9149066	0.0002128	0.00009186	0.9555311	4.6804336
6.1534524							
0.00001250	111.6840496	8934724.	17.5621015	0.0002195	0.00008515	0.9839112	4.7100900
6.3467775							
0.00001375	122.8520685	8934696.	16.4553746	0.0002263	0.00007845	1.0121979	4.7397916

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6.5401479							
0.00001500	134.0200281	8934669.	15.5332063	0.0002330	0.00007175	1.0403913	4.7695385
6.7335635							
0.00001625	145.1879231	8934641.	14.7530062	0.0002397	0.00006505	1.0684912	4.7993308
6.9270245							
0.00001750	156.3557479	8934614.	14.0843524	0.0002465	0.00005835	1.0964975	4.8291683
7.1205308							
0.00001875	167.5234973	8934587.	13.5049358	0.0002532	0.00005166	1.1244103	4.8590511
7.3140824							
0.00002000	178.6911658	8934558.	12.9980244	0.0002600	0.00004496	1.1522295	4.8889792
7.5076792							
0.00002125	189.8587480	8934529.	12.5508231	0.0002667	0.00003827	1.1799549	4.9189526
7.7013214							
0.00002250	201.0262386	8934499.	12.1533802	0.0002735	0.00003158	1.2075865	4.9489713
7.8950088							
0.00002375	212.1936321	8934469.	11.7978392	0.0002802	0.00002489	1.2351242	4.9790353
8.0887415							
0.00002500	223.3609232	8934437.	11.4779148	0.0002869	0.00001820	1.2625680	5.0091446
8.2825196							
0.00002625	234.5281065	8934404.	11.1885189	0.0002937	0.00001151	1.2899178	5.0392991
8.4763429							
0.00002750	245.6951765	8934370.	10.9254885	0.0003005	0.00000483	1.3171735	5.0694990
8.6702115							
0.00002875	256.8621278	8934335.	10.6853846	0.0003072	-0.00000186	1.3443351	5.0997442
8.8641255							
0.00003000	268.0289551	8934299.	10.4653415	0.0003140	-0.00000854	1.3714024	5.1300347
9.0580847							
0.00003125	279.1956530	8934261.	10.2629518	0.0003207	-0.00001522	1.3983754	5.1603704
9.2520892							
0.00003250	290.3622125	8934222.	10.0761785	0.0003275	-0.00002190	1.4252541	5.1907515
9.4461390							
0.00003375	301.5285419	8934179.	9.9032860	0.0003342	-0.00002858	1.4520383	5.2211772
9.6402335							
0.00003500	312.6943649	8934125.	9.7427852	0.0003410	-0.00003525	1.4787276	5.2516458
9.8343708							
0.00003625	323.8593483	8934051.	9.5933919	0.0003478	-0.00004193	1.5053217	5.2821549
10.0285486							
0.00003750	335.0231436	8933950.	9.4539930	0.0003545	-0.00004860	1.5318201	5.3127019
10.2227644							
0.00003875	346.1854287	8933818.	9.3236192	0.0003613	-0.00005527	1.5582225	5.3432844
10.4170156							
0.00004000	357.3459027	8933648.	9.2014224	0.0003681	-0.00006194	1.5845285	5.3739001
10.6113001							
0.00004125	368.5042898	8933437.	9.0866572	0.0003748	-0.00006861	1.6107378	5.4045467
10.8056154							
0.00004250	379.6603406	8933184.	8.9786665	0.0003816	-0.00007528	1.6368500	5.4352221
10.9999596							
0.00004375	390.8138317	8932888.	8.8768678	0.0003884	-0.00008195	1.6628648	5.4659246
11.1943308							
0.00004500	401.9645638	8932546.	8.7807439	0.0003951	-0.00008862	1.6887820	5.4966522
11.3887272							
0.00004625	413.1123590	8932159.	8.6898335	0.0004019	-0.00009528	1.7146012	5.5274034
11.5831472							
0.00004750	424.2570576	8931728.	8.6037239	0.0004087	-0.000102	1.7403223	5.5581767
11.7775892							
0.00004875	435.3985145	8931252.	8.5220448	0.0004154	-0.000109	1.7659451	5.5889707
11.9720520							
0.00005125	450.9546919	8799116.	8.3347539	0.0004272	-0.000124	1.8099252	5.5972234
12.3076422 C							
0.00005375	471.5725644	8773443.	8.1901124	0.0004402	-0.000138	1.8587027	5.6447988
12.6825550 C							
0.00005625	492.0774040	8748043.	8.0576637	0.0004532	-0.000151	1.9069650	5.6912907
13.0563845 C							
0.00005875	512.4812892	8723086.	7.9359018	0.0004662	-0.000165	1.9547264	5.7367850
13.4292162 C							
0.00006125	532.7941815	8698681.	7.8235579	0.0004792	-0.000179	2.0019988	5.7813528
13.8011215 C							
0.00006375	553.0259385	8674917.	7.7195669	0.0004921	-0.000193	2.0487950	5.8250730
14.1721792 C							

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0.00006625	573.1862017	8651867.	7.6230280	0.0005050	-0.000207	2.0951282	5.8680319
14.5424756 C							
0.00006875	593.2842942	8629590.	7.5331752	0.0005179	-0.000221	2.1410123	5.9103230
14.9121042 C							
0.00007125	613.3291247	8608128.	7.4493531	0.0005308	-0.000235	2.1864614	5.9520464
15.2811652 C							
0.00007375	633.3238269	8587442.	7.3709600	0.0005436	-0.000249	2.2314804	5.9932269
15.6496832 C							
0.00007625	653.2619726	8567370.	7.2974020	0.0005564	-0.000263	2.2760547	6.0337320
16.0175257 C							
0.00007875	673.1672317	8548155.	7.2283718	0.0005692	-0.000277	2.3202283	6.0739116
16.3850429 C							
0.00008125	693.0357024	8529670.	7.1634223	0.0005820	-0.000291	2.3639941	6.1136970
16.7521657 C							
0.00008375	712.8615620	8511780.	7.1021356	0.0005948	-0.000306	2.4073380	6.1529604
17.1187666 C							
0.00008625	732.6696480	8494721.	7.0443638	0.0006076	-0.000320	2.4503116	6.1921292
17.4852729 C							
0.00008875	752.4305014	8478090.	6.9895969	0.0006203	-0.000334	2.4928516	6.2306551
17.8511363 C							
0.00009125	772.1821767	8462270.	6.9378500	0.0006331	-0.000348	2.5350395	6.2692310
18.2170498 C							
0.00009375	791.8913423	8446841.	6.8886431	0.0006458	-0.000362	2.5768014	6.3072097
18.5823660 C							
0.00009625	811.5905132	8432109.	6.8420035	0.0006585	-0.000376	2.6182100	6.3452190
18.9477127 C							
0.00009875	831.2600924	8417824.	6.7975938	0.0006713	-0.000390	2.6592196	6.3828517
19.3126829 C							
0.0001013	850.9105739	8404055.	6.7553222	0.0006840	-0.000404	2.6998551	6.4203228
19.6774916 C							
0.0001038	870.5513197	8390856.	6.7150968	0.0006967	-0.000419	2.7401378	6.4578212
20.0423275 C							
0.0001063	890.1568135	8377946.	6.6765909	0.0007094	-0.000433	2.7800065	6.4947850
20.4066288 C							
0.0001088	909.7554552	8365567.	6.6398838	0.0007221	-0.000447	2.8195300	6.5318386
20.7710198 C							
0.0001113	929.3420817	8353637.	6.6048166	0.0007348	-0.000461	2.8586951	6.5688602
21.1353790 C							
0.0001138	948.8993003	8341972.	6.5711564	0.0007475	-0.000475	2.8974583	6.6054385
21.4992948 C							
0.0001163	968.4496558	8330750.	6.5389704	0.0007602	-0.000490	2.9358767	6.6421057
21.8632995 C							
0.0001188	987.9931393	8319942.	6.5081653	0.0007728	-0.000504	2.9739501	6.6788619
22.2273932 C							
0.0001213	1008.	8309353.	6.4785058	0.0007855	-0.000518	3.0116239	6.7151793
22.5910480 C							
0.0001238	1027.	8299107.	6.4500439	0.0007982	-0.000532	3.0489439	6.7514939
22.9547002 C							
0.0001263	1047.	8289213.	6.4227334	0.0008109	-0.000546	3.0859192	6.7878969
23.3184407 C							
0.0001288	1066.	8279649.	6.3965071	0.0008236	-0.000561	3.1225497	6.8243883
23.6822696 C							
0.0001313	1085.	8270239.	6.3711519	0.0008362	-0.000575	3.1587779	6.8603927
24.0456114 C							
0.0001338	1105.	8261128.	6.3467658	0.0008489	-0.000589	3.1946612	6.8964790
24.4090352 C							
0.0001363	1124.	8252301.	6.3232967	0.0008615	-0.000603	3.2302000	6.9326532
24.7725469 C							
0.0001388	1144.	8243742.	6.3006953	0.0008742	-0.000617	3.2653940	6.9689154
25.1361466 C							
0.0001413	1163.	8235379.	6.2788551	0.0008869	-0.000632	3.3002193	7.0050185
25.4995873 C							
0.0001438	1183.	8227192.	6.2577249	0.0008995	-0.000646	3.3346720	7.0409147
25.8628209 C							
0.0001463	1202.	8219238.	6.2373378	0.0009122	-0.000660	3.3687801	7.0768984
26.2261422 C							
0.0001488	1221.	8211504.	6.2176563	0.0009249	-0.000674	3.4025434	7.1129699
26.5895512 C							
0.0001588	1299.	8182386.	6.1451074	0.0009755	-0.000731	3.5340566	7.2571518

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28.0430830 C							
0.0001688	1376.	8155899.	6.0812547	0.0010262	-0.000788	3.6599621	7.4018171
29.4970984 C							
0.0001788	1454.	8131540.	6.0245409	0.0010769	-0.000845	3.7802131	7.5464545
30.9510857 C							
0.0001888	1531.	8109142.	5.9740568	0.0011276	-0.000901	3.8949048	7.6922972
32.4062785 C							
0.0001988	1608.	8088294.	5.9286914	0.0011783	-0.000958	4.0039511	7.8383615
33.8616928 C							
0.0002088	1684.	8068880.	5.8878685	0.0012291	-0.001015	4.1074163	7.9856133
35.3182946 C							
0.0002188	1761.	8050702.	5.8509611	0.0012799	-0.001072	4.2052849	8.1340266
36.7760579 C							
0.0002288	1838.	8033533.	5.8173517	0.0013307	-0.001128	4.2975008	8.2829116
38.2342929 C							
0.0002388	1914.	8017328.	5.7867666	0.0013816	-0.001185	4.3841147	8.4332430
39.6939743 C							
0.0002488	1990.	8001968.	5.7588423	0.0014325	-0.001242	4.4651099	8.5850289
41.1551101 C							
0.0002588	2067.	7987305.	5.7331723	0.0014835	-0.001298	4.5404330	8.7375343
42.6169656 C							
0.0002688	2143.	7973287.	5.7095628	0.0015344	-0.001355	4.6100962	8.8912107
44.0799920 C							
0.0002788	2219.	7959861.	5.6878304	0.0015855	-0.001411	4.6740986	9.0463669
45.5444981 C							
0.0002888	2295.	7946965.	5.6677809	0.0016366	-0.001467	4.7324232	9.2030111
47.0104923 C							
0.0002988	2370.	7934541.	5.6492464	0.0016877	-0.001524	4.7850526	9.3611519
48.4779831 C							
0.0003088	2446.	7922519.	5.6320161	0.0017389	-0.001580	4.8319524	9.5202194
49.9464007 C							
0.0003188	2522.	7910872.	5.6160025	0.0017901	-0.001636	4.8731200	9.6805410
51.4160723 C							
0.0003288	2596.	7897458.	5.6016953	0.0018416	-0.001693	4.9086672	9.8478428
52.0000000 CY							
0.0003388	2668.	7876133.	5.5906986	0.0018938	-0.001748	4.9388237	10.0393682
52.0000000 CY							
0.0003488	2736.	7845102.	5.5835030	0.0019472	-0.001802	4.9634076	10.2629583
52.0000000 CY							
0.0003588	2799.	7800869.	5.5792810	0.0020016	-0.001855	4.9819727	10.5133103
52.0000000 CY							
0.0003688	2854.	7738639.	5.5767205	0.0020564	-0.001908	4.9941202	10.7789838
52.0000000 CY							
0.0003788	2902.	7662955.	5.5742509	0.0021112	-0.001960	4.9996347	11.0441708
52.0000000 CY							
0.0003888	2945.	7576218.	5.5708210	0.0021657	-0.002013	4.9999603	11.2970990
52.0000000 CY							
0.0003988	2983.	7480349.	5.5660767	0.0022195	-0.002067	4.9984947	11.5328381
52.0000000 CY							
0.0004088	3016.	7378972.	5.5605826	0.0022729	-0.002121	4.9987187	11.7569366
52.0000000 CY							
0.0004188	3046.	7274562.	5.5547226	0.0023260	-0.002176	4.9989569	11.9734066
52.0000000 CY							
0.0004288	3074.	7168614.	5.5486640	0.0023790	-0.002230	4.9990207	12.1840073
52.0000000 CY							
0.0004388	3099.	7062159.	5.5425077	0.0024318	-0.002285	4.9989278	12.3898508
52.0000000 CY							
0.0004488	3121.	6955571.	5.5365335	0.0024845	-0.002340	4.9986665	12.5944938
52.0000000 CY							
0.0004588	3142.	6849692.	5.5306115	0.0025372	-0.002394	4.9981791	12.7963656
52.0000000 CY							
0.0004688	3162.	6745088.	5.5247530	0.0025897	-0.002449	4.9990677	12.9956654
52.0000000 CY							
0.0004788	3180.	6642097.	5.5189792	0.0026422	-0.002504	4.9999434	13.1927457
52.0000000 CY							
0.0004888	3197.	6540372.	5.5137238	0.0026948	-0.002559	4.9996235	13.3938231
52.0000000 CY							
0.0004988	3212.	6440352.	5.5083292	0.0027473	-0.002614	4.9988609	13.5898383
52.0000000 CY							

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0.0005088	3227.	6342259.	5.5030236	0.0027997	-0.002669	4.9974554	13.7840402
52.0000000 CY							
0.0005188	3240.	6246042.	5.4982156	0.0028522	-0.002724	4.9998974	13.9826501
52.0000000 CY							
0.0005288	3253.	6152030.	5.4933133	0.0029046	-0.002779	4.9990859	14.1770231
52.0000000 CY							
0.0005388	3265.	6059560.	5.4887251	0.0029571	-0.002835	4.9972391	14.3734628
52.0000000 CY							
0.0005488	3276.	5969642.	5.4843075	0.0030095	-0.002890	4.9997873	14.5699542
52.0000000 CY							
0.0006088	3330.	5469956.	5.4609551	0.0033244	-0.003220	4.9978757	15.7507672
52.0000000 CY							
0.0006688	3368.	5036518.	5.4430538	0.0036400	-0.003549	4.9997629	16.9560317
52.0000000 CY							
0.0007288	3396.	4660039.	5.4291610	0.0039565	-0.003878	4.9970811	18.1837138
52.0000000 CY							

Axial Thrust Force = 186.610 kips

Bending Max Casing Run Curvature Stress rad/in. ksi	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi
-----	-----	-----	-----	-----	-----	-----	-----
0.00000125	11.1148877	8891910.	165.9448417	0.0002074	0.0001940	0.9349315	5.8498833
6.0135521							
0.00000250	22.2274093	8890964.	85.6608591	0.0002142	0.0001873	0.9633307	5.8791779
6.2065154							
0.00000375	33.3399200	8890645.	58.8999515	0.0002209	0.0001806	0.9916370	5.9085182
6.3995244							
0.00000500	44.4524145	8890483.	45.5198126	0.0002276	0.0001738	1.0198505	5.9379041
6.5925791							
0.00000625	55.5648872	8890382.	37.4919813	0.0002343	0.0001671	1.0479709	5.9673357
6.7856794							
0.00000750	66.6773329	8890311.	32.1403036	0.0002411	0.0001604	1.0759982	5.9968129
6.9788254							
0.00000875	77.7897459	8890257.	28.3178567	0.0002478	0.0001537	1.1039324	6.0263359
7.1720171							
0.00001000	88.9021210	8890212.	25.4511790	0.0002545	0.0001470	1.1317733	6.0559044
7.3652544							
0.00001125	100.0144526	8890174.	23.2216807	0.0002612	0.0001403	1.1595210	6.0855187
7.5585374							
0.00001250	111.1267352	8890139.	21.4382081	0.0002680	0.0001336	1.1871753	6.1151786
7.7518661							
0.00001375	122.2389636	8890106.	19.9791177	0.0002747	0.0001269	1.2147362	6.1448842
7.9452404							
0.00001500	133.3511322	8890075.	18.7633141	0.0002814	0.0001202	1.2422036	6.1746354
8.1386604							
0.00001625	144.4632355	8890045.	17.7346540	0.0002882	0.0001135	1.2695774	6.2044323
8.3321261							
0.00001750	155.5752682	8890015.	16.8530354	0.0002949	0.0001068	1.2968576	6.2342749
8.5256374							
0.00001875	166.6872248	8889985.	16.0890500	0.0003017	0.0001001	1.3240441	6.2641632
8.7191944							
0.00002000	177.7990999	8889955.	15.4206414	0.0003084	0.00009341	1.3511367	6.2940971
8.9127971							
0.00002125	188.9108879	8889924.	14.8309433	0.0003152	0.00008672	1.3781356	6.3240767
9.1064454							
0.00002250	200.0225836	8889893.	14.3068371	0.0003219	0.00008003	1.4050405	6.3541019
9.3001394							
0.00002375	211.1341814	8889860.	13.8379664	0.0003287	0.00007334	1.4318514	6.3841728
9.4938791							
0.00002500	222.2456759	8889827.	13.4160457	0.0003354	0.00006665	1.4585682	6.4142894
9.6876644							
0.00002625	233.3570617	8889793.	13.0343679	0.0003422	0.00005996	1.4851909	6.4444517

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9.8814954							
0.00002750	244.4683333	8889758.	12.6874454	0.0003489	0.00005328	1.5117194	6.4746596
10.0753721							
0.00002875	255.5794853	8889721.	12.3707448	0.0003557	0.00004660	1.5381536	6.5049133
10.2692945							
0.00003000	266.6905122	8889684.	12.0804885	0.0003624	0.00003991	1.5644935	6.5352125
10.4632625							
0.00003125	277.8014086	8889645.	11.8135030	0.0003692	0.00003323	1.5907389	6.5655575
10.6572763							
0.00003250	288.9121690	8889605.	11.5671034	0.0003759	0.00002656	1.6168899	6.5959482
10.8513357							
0.00003375	300.0227881	8889564.	11.3390022	0.0003827	0.00001988	1.6429463	6.6263845
11.0454407							
0.00003500	311.1332604	8889522.	11.1272390	0.0003895	0.00001320	1.6689080	6.6568665
11.2395915							
0.00003625	322.2435803	8889478.	10.9301236	0.0003962	0.00000653	1.6947751	6.6873941
11.4337879							
0.00003750	333.3537426	8889433.	10.7461913	0.0004030	-1.42827E-07	1.7205473	6.7179675
11.6280300							
0.00003875	344.4637417	8889387.	10.5741662	0.0004097	-0.00000681	1.7462248	6.7485865
11.8223178							
0.00004000	355.5735722	8889339.	10.4129320	0.0004165	-0.00001348	1.7718073	6.7792512
12.0166512							
0.00004125	366.6832287	8889290.	10.2615078	0.0004233	-0.00002015	1.7972948	6.8099616
12.2110304							
0.00004250	377.7927043	8889240.	10.1190280	0.0004301	-0.00002682	1.8226873	6.8407177
12.4054552							
0.00004375	388.9019507	8889187.	9.9847256	0.0004368	-0.00003348	1.8479845	6.8715192
12.5999254							
0.00004500	400.0107980	8889129.	9.8579184	0.0004436	-0.00004014	1.8731864	6.9023649
12.7944399							
0.00004625	411.1190070	8889060.	9.7379974	0.0004504	-0.00004681	1.8982927	6.9332532
12.9889970							
0.00004750	422.2263186	8888975.	9.6244176	0.0004572	-0.00005347	1.9233029	6.9641823
13.1835948							
0.00004875	433.3324729	8888871.	9.5166900	0.0004639	-0.00006012	1.9482169	6.9951503
13.3782315							
0.00005125	455.5403207	8888592.	9.3170730	0.0004775	-0.00007344	1.9977549	7.0571953
13.7676140							
0.00005375	477.7407164	8888199.	9.1361109	0.0004911	-0.00008675	2.0469042	7.1193739
14.1571302							
0.00005625	499.9320549	8887681.	8.9713082	0.0005046	-0.000100	2.0956630	7.1816732
14.5467669							
0.00005875	522.1129689	8887029.	8.8205951	0.0005182	-0.000113	2.1440293	7.2440812
14.9365125							
0.00006125	539.1782324	8802910.	8.6599159	0.0005304	-0.000128	2.1871405	7.2669336
15.2867024 C							
0.00006375	559.9890071	8784141.	8.5272808	0.0005436	-0.000142	2.2333972	7.3183339
15.6654402 C							
0.00006625	580.6794823	8764973.	8.4041149	0.0005568	-0.000155	2.2791450	7.3686949
16.0431387 C							
0.00006875	601.2633290	8745648.	8.2894339	0.0005699	-0.000169	2.3243986	7.4181136
16.4198949 C							
0.00007125	621.7499380	8726315.	8.1823745	0.0005830	-0.000183	2.3691684	7.4666518
16.7957705 C							
0.00007375	642.1487918	8707102.	8.0821945	0.0005961	-0.000197	2.4134651	7.5143796
17.1708359 C							
0.00007625	662.4693323	8688122.	7.9882526	0.0006091	-0.000211	2.4573004	7.5613755
17.5451692 C							
0.00007875	682.7208396	8669471.	7.8999924	0.0006221	-0.000224	2.5006863	7.6077251
17.9188563 C							
0.00008125	702.8917804	8650976.	7.8168141	0.0006351	-0.000238	2.5436046	7.6532514
18.2917201 C							
0.00008375	723.0056741	8632904.	7.7383734	0.0006481	-0.000252	2.5860881	7.6982232
18.6640294 C							
0.00008625	743.0723226	8615331.	7.6643049	0.0006610	-0.000266	2.6281518	7.7427569
19.0359006 C							
0.00008875	763.0856152	8598148.	7.5942014	0.0006740	-0.000280	2.6697860	7.7867557
19.4072370 C							

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0.00009125	783.0438794	8581303.	7.5277165	0.0006869	-0.000294	2.7109863	7.8301654
19.7779841 C							
0.00009375	802.9749300	8565066.	7.4647060	0.0006998	-0.000308	2.7517979	7.8733807
20.1485370 C							
0.00009625	822.8469678	8549059.	7.4047237	0.0007127	-0.000322	2.7921681	7.9159119
20.5184056 C							
0.00009875	842.6967493	8533638.	7.3477287	0.0007256	-0.000336	2.8321571	7.9583007
20.8881319 C							
0.0001013	862.5009456	8518528.	7.2933738	0.0007385	-0.000350	2.8717260	8.0001769
21.2573456 C							
0.0001038	882.2839304	8503941.	7.2415922	0.0007513	-0.000364	2.9109158	8.0419142
21.6264205 C							
0.0001063	902.0243515	8489641.	7.1920865	0.0007642	-0.000378	2.9496895	8.0831559
21.9949996 C							
0.0001088	921.7540351	8475899.	7.1448668	0.0007770	-0.000392	2.9881033	8.1244288
22.3636100 C							
0.0001113	941.4347166	8462335.	7.0995701	0.0007898	-0.000406	3.0260877	8.1650587
22.7315775 C							
0.0001138	961.1084605	8449305.	7.0562939	0.0008027	-0.000420	3.0637200	8.2057857
23.0996420 C							
0.0001163	980.7483892	8436545.	7.0147592	0.0008155	-0.000434	3.1009495	8.2461089
23.4673027 C							
0.0001188	1000.	8424138.	6.9749199	0.0008283	-0.000448	3.1377991	8.2862480
23.8347793 C							
0.0001213	1020.	8412184.	6.9367507	0.0008411	-0.000462	3.1742972	8.3264828
24.2023515 C							
0.0001238	1040.	8400375.	6.8999578	0.0008539	-0.000476	3.2103759	8.3661223
24.5693285 C							
0.0001263	1059.	8388955.	6.8646313	0.0008667	-0.000491	3.2460977	8.4057956
24.9363394 C							
0.0001288	1079.	8377923.	6.8307019	0.0008795	-0.000505	3.2814685	8.4455633
25.3034445 C							
0.0001313	1098.	8367034.	6.7979262	0.0008922	-0.000519	3.3164288	8.4848022
25.6700209 C							
0.0001338	1118.	8356464.	6.7663748	0.0009050	-0.000533	3.3510296	8.5240376
26.0365938 C							
0.0001363	1137.	8346232.	6.7360049	0.0009178	-0.000547	3.3852797	8.5633662
26.4032600 C							
0.0001388	1157.	8336226.	6.7066818	0.0009306	-0.000561	3.4191528	8.6025036
26.7697348 C							
0.0001413	1176.	8326399.	6.6783213	0.0009433	-0.000575	3.4526387	8.6413317
27.1359005 C							
0.0001438	1196.	8316865.	6.6509693	0.0009561	-0.000589	3.4857745	8.6802521
27.5021583 C							
0.0001463	1215.	8307609.	6.6245742	0.0009688	-0.000603	3.5185598	8.7192648
27.8685085 C							
0.0001488	1234.	8298530.	6.5990151	0.0009816	-0.000617	3.5509668	8.7580563
28.2346375 C							
0.0001588	1312.	8264278.	6.5047343	0.0010326	-0.000674	3.6769746	8.9127881
29.6987194 C							
0.0001688	1389.	8232868.	6.4214299	0.0010836	-0.000730	3.7971739	9.0665527
31.1618339 C							
0.0001788	1466.	8204030.	6.3474240	0.0011346	-0.000787	3.9116412	9.2202019
32.6248332 C							
0.0001888	1543.	8177463.	6.2813419	0.0011856	-0.000843	4.0204187	9.3743007
34.0882820 C							
0.0001988	1620.	8152695.	6.2218347	0.0012366	-0.000900	4.1234408	9.5279672
35.5512985 C							
0.0002088	1697.	8129687.	6.1681919	0.0012876	-0.000956	4.2208038	9.6826162
37.0152974 C							
0.0002188	1774.	8108075.	6.1194632	0.0013386	-0.001013	4.3124407	9.8373328
38.4793640 C							
0.0002288	1850.	8087850.	6.0752162	0.0013897	-0.001069	4.3984301	9.9935174
39.9448986 C							
0.0002388	1926.	8068671.	6.0346646	0.0014408	-0.001126	4.4786733	10.1496241
41.4103554 C							
0.0002488	2003.	8050562.	5.9975707	0.0014919	-0.001182	4.5532444	10.3071540
42.8772352 C							
0.0002588	2079.	8033393.	5.9635269	0.0015431	-0.001238	4.6221246	10.4660576

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44.3454888 C							
0.0002688	2155.	8016963.	5.9320447	0.0015942	-0.001295	4.6852501	10.6251773
45.8139585 C							
0.0002788	2230.	8001290.	5.9030070	0.0016455	-0.001351	4.7426661	10.7857999
47.2839312 C							
0.0002888	2306.	7986295.	5.8761609	0.0016967	-0.001407	4.7943552	10.9479322
48.7554135 C							
0.0002988	2382.	7971885.	5.8512453	0.0017481	-0.001464	4.8402891	11.1112188
50.2280500 C							
0.0003088	2457.	7957975.	5.8280228	0.0017994	-0.001520	4.8804429	11.2752146
51.7013958 C							
0.0003188	2531.	7940817.	5.8074320	0.0018511	-0.001575	4.9150248	11.4500673
52.0000000 CY							
0.0003288	2602.	7914633.	5.7909324	0.0019038	-0.001630	4.9441857	11.6519802
52.0000000 CY							
0.0003388	2669.	7878539.	5.7787223	0.0019575	-0.001684	4.9676701	11.8864664
52.0000000 CY							
0.0003488	2730.	7829357.	5.7717171	0.0020129	-0.001736	4.9851906	12.1665091
52.0000000 CY							
0.0003588	2788.	7771743.	5.7685408	0.0020695	-0.001787	4.9961218	12.4823199
52.0000000 CY							
0.0003688	2842.	7707558.	5.7677079	0.0021268	-0.001837	4.9999960	12.8213499
52.0000000 CY							
0.0003788	2892.	7634784.	5.7677135	0.0021845	-0.001887	4.9992293	13.1691160
52.0000000 CY							
0.0003888	2936.	7553681.	5.7674452	0.0022421	-0.001937	4.9998074	13.5137854
52.0000000 CY							
0.0003988	2977.	7464827.	5.7661247	0.0022992	-0.001987	4.9999926	13.8461418
52.0000000 CY							
0.0004088	3012.	7368943.	5.7633441	0.0023558	-0.002038	4.9983109	14.1604205
52.0000000 CY							
0.0004188	3043.	7267905.	5.7592749	0.0024117	-0.002090	4.9986357	14.4574384
52.0000000 CY							
0.0004288	3072.	7164397.	5.7545960	0.0024673	-0.002142	4.9987457	14.7445135
52.0000000 CY							
0.0004388	3097.	7059755.	5.7495948	0.0025226	-0.002194	4.9986732	15.0247746
52.0000000 CY							
0.0004488	3121.	6954314.	5.7443906	0.0025778	-0.002246	4.9984067	15.2994919
52.0000000 CY							
0.0004588	3142.	6849380.	5.7390683	0.0026328	-0.002299	4.9978973	15.5696159
52.0000000 CY							
0.0004688	3162.	6745491.	5.7336845	0.0026877	-0.002351	4.9999994	15.8358242
52.0000000 CY							
0.0004788	3180.	6642938.	5.7283498	0.0027424	-0.002404	4.9998923	16.0995946
52.0000000 CY							
0.0004888	3197.	6541659.	5.7233588	0.0027973	-0.002457	4.9995079	16.3651374
52.0000000 CY							
0.0004988	3213.	6442056.	5.7182154	0.0028520	-0.002510	4.9986710	16.6255719
52.0000000 CY							
0.0005088	3228.	6344088.	5.7130770	0.0029065	-0.002563	4.9979604	16.8831143
52.0000000 CY							
0.0005188	3241.	6248029.	5.7083240	0.0029612	-0.002615	4.9998357	17.1434668
52.0000000 CY							
0.0005288	3254.	6154200.	5.7034948	0.0030157	-0.002668	4.9989153	17.3998953
52.0000000 CY							
0.0005388	3266.	6061706.	5.6989039	0.0030703	-0.002721	4.9974446	17.6572441
52.0000000 CY							
0.0005488	3277.	5971796.	5.6944118	0.0031248	-0.002774	4.9996961	17.9134945
52.0000000 CY							
0.0006088	3331.	5471654.	5.6703197	0.0034518	-0.003092	4.9993972	19.4468297
52.0000000 CY							
0.0006688	3369.	5037542.	5.6510064	0.0037791	-0.003410	4.9995841	20.9890121
52.0000000 CY							
0.0007288	3396.	4660143.	5.6351182	0.0041066	-0.003727	5.0000000	22.5363567
52.0000000 CY							

Summary of Results for Nominal Moment Capacity for Section 1

 Moment values interpolated at maximum compressive strain = 0.003
 or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
-----	-----	-----	-----	-----
1	142.140	3273.800	0.00300000	-0.00287957
2	186.610	3250.323	0.00300000	-0.00265307

Note that the values of moment capacity in the table above are not
 factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
 the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
 factor to compute ultimate moment capacity according to ACI 318,
 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
 bending stiffnesses computed for common resistance factor values used for
 reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
-----	-----	-----	-----	-----	-----	-----
1	0.65	142.140000	3274.	92.391000	2128.	7976022.
2	0.65	186.610000	3250.	121.296500	2113.	8026020.
1	0.75	142.140000	3274.	106.605000	2455.	7921089.
2	0.75	186.610000	3250.	139.957500	2438.	7961531.
1	0.90	142.140000	3274.	127.926000	2946.	7573241.
2	0.90	186.610000	3250.	167.949000	2925.	7573953.

Pile Section No. 2:

 Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	7.000000 ft
Shaft Diameter	=	9.560000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.655000 in
Number of Reinforcing Bars	=	1 bar
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	71.780366 sq. in.
Total Area of Reinforcing Steel	=	2.250000 sq. in.
Area Ratio of Steel Reinforcement	=	3.13 percent
Edge-to-Edge Bar Spacing	=	-1.69300 in
Maximum Concrete Aggregate Size	=	0.375000 in
Ratio of Bar Spacing to Aggregate Size	=	-4.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = $0.85 F_c A_c + F_y A_s$	=	430.504 kips
Tensile Load for Cracking of Concrete	=	-39.723 kips
Nominal Axial Tensile Capacity	=	-135.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

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Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
-----	-----	-----	-----	-----
1	1.693000	2.250000	0.00000	0.00000

NOTE: The positions of the above rebars were computed by LPILE

Concrete Properties:

Compressive Strength of Concrete	=	5000. psi
Modulus of Elasticity of Concrete	=	4030509. psi
Modulus of Rupture of Concrete	=	-530.33009 psi
Compression Strain at Peak Stress	=	0.002109
Tensile Strain at Fracture of Concrete	=	-0.0001150
Maximum Coarse Aggregate Size	=	0.375000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
-----	-----
1	142.140
2	186.610

Definitions of Run Messages and Notes:

- C = concrete in section has cracked in tension.
- Y = stress in reinforcing steel has reached yield stress.
- T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
- Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
 Position of neutral axis is measured from edge of compression side of pile.
 Compressive stresses and strains are positive in sign.
 Tensile stresses and strains are negative in sign.

Axial Thrust Force = 142.140 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
-----	-----	-----	-----	-----	-----	-----	-----	-----
0.00000125	1.9984209	1598737.	316.7812515	0.0003960	0.0003840	1.7011266	11.3395021	
0.00000250	3.9921886	1596875.	160.7831932	0.0004020	0.0003781	1.7238949	11.3691450	
0.00000375	5.9859267	1596247.	108.7849897	0.0004079	0.0003721	1.7466009	11.3989129	
0.00000500	7.9796204	1595924.	82.7867498	0.0004139	0.0003661	1.7692444	11.4288057	
0.00000625	9.9732546	1595721.	67.1884953	0.0004199	0.0003602	1.7918251	11.4588235	
0.00000750	11.9668146	1595575.	56.7902337	0.0004259	0.0003542	1.8143430	11.4889663	
0.00000875	13.9602854	1595461.	49.3633965	0.0004319	0.0003483	1.8367978	11.5192339	
0.00001000	15.9536522	1595365.	43.7936996	0.0004379	0.0003423	1.8591894	11.5496267	
0.00001125	17.9469000	1595280.	39.4620962	0.0004439	0.0003364	1.8815176	11.5801445	
0.00001250	19.9400140	1595201.	35.9971584	0.0004500	0.0003305	1.9037822	11.6107873	
0.00001375	21.9329793	1595126.	33.1625227	0.0004560	0.0003245	1.9259831	11.6415550	
0.00001500	23.9257810	1595052.	30.8006137	0.0004620	0.0003186	1.9481201	11.6724478	
0.00001625	25.9184041	1594979.	28.8023407	0.0004680	0.0003127	1.9701931	11.7034657	
0.00001750	27.9108339	1594905.	27.0897815	0.0004741	0.0003068	1.9922017	11.7346085	
0.00001875	29.9030553	1594830.	25.6057936	0.0004801	0.0003009	2.0141459	11.7658764	
0.00002000	31.8950536	1594753.	24.3075198	0.0004862	0.0002950	2.0360256	11.7972694	
0.00002125	33.8868137	1594674.	23.1621870	0.0004922	0.0002890	2.0578404	11.8287874	

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0.00002250	35.8783209	1594592.	22.1443051	0.0004982	0.0002831	2.0795903	11.8604305
0.00002375	37.8695601	1594508.	21.2337503	0.0005043	0.0002773	2.1012751	11.8921987
0.00002500	39.8605164	1594421.	20.4144236	0.0005104	0.0002714	2.1228947	11.9240922
0.00002625	41.8511751	1594330.	19.6732923	0.0005164	0.0002655	2.1444487	11.9561106
0.00002750	43.8415211	1594237.	18.9996935	0.0005225	0.0002596	2.1659371	11.9882541
0.00002875	45.8315395	1594141.	18.3848186	0.0005286	0.0002537	2.1873597	12.0205229
0.00003000	47.8212154	1594041.	17.8213272	0.0005346	0.0002478	2.2087163	12.0529167
0.00003125	49.8105339	1593937.	17.3030532	0.0005407	0.0002420	2.2300068	12.0854358
0.00003250	51.7994800	1593830.	16.8247793	0.0005468	0.0002361	2.2512309	12.1180801
0.00003375	53.7880388	1593720.	16.3820611	0.0005529	0.0002302	2.2723885	12.1508496
0.00003500	55.7761954	1593606.	15.9710889	0.0005590	0.0002244	2.2934795	12.1837444
0.00003625	57.7639349	1593488.	15.5885789	0.0005651	0.0002185	2.3145036	12.2167644
0.00003750	59.7512422	1593366.	15.2316847	0.0005712	0.0002127	2.3354607	12.2499097
0.00003875	61.7381024	1593241.	14.8979274	0.0005773	0.0002068	2.3563506	12.2831803
0.00004000	63.7245007	1593113.	14.5851381	0.0005834	0.0002010	2.3771731	12.3165763
0.00004125	65.7104219	1592980.	14.2914104	0.0005895	0.0001952	2.3979281	12.3500976
0.00004250	67.6958512	1592844.	14.0150626	0.0005956	0.0001893	2.4186153	12.3837443
0.00004375	69.6807736	1592703.	13.7546050	0.0006018	0.0001835	2.4392347	12.4175164
0.00004500	71.6651741	1592559.	13.5087133	0.0006079	0.0001777	2.4597860	12.4514139
0.00004625	73.6490377	1592412.	13.2762066	0.0006140	0.0001719	2.4802691	12.4854370
0.00004750	75.6323494	1592260.	13.0560282	0.0006202	0.0001661	2.5006838	12.5195855
0.00004875	77.6150943	1592104.	12.8472298	0.0006263	0.0001603	2.5210299	12.5538595
0.00005125	81.5788236	1591782.	12.4604422	0.0006386	0.0001486	2.5615156	12.6227842
0.00005375	85.5401055	1591444.	12.1099573	0.0006509	0.0001371	2.6017249	12.6922113
0.00005625	89.4988197	1591090.	11.7909347	0.0006632	0.0001255	2.6416563	12.7621411
0.00005875	93.4548462	1590721.	11.4993582	0.0006756	0.0001139	2.6813086	12.8325739
0.00006125	97.4080645	1590336.	11.2318672	0.0006880	0.0001024	2.7206802	12.9035100
0.00006375	101.3583541	1589935.	10.9856282	0.0007003	0.00009088	2.7597698	12.9749495
0.00006625	105.3055944	1589518.	10.7582355	0.0007127	0.00007938	2.7985760	13.0468929
0.00006875	109.2496648	1589086.	10.5476334	0.0007251	0.00006790	2.8370973	13.1193405
0.00007125	113.1904443	1588638.	10.3520545	0.0007376	0.00005643	2.8753324	13.1922926
0.00007375	117.1278121	1588174.	10.1699712	0.0007500	0.00004499	2.9132798	13.2657495
0.00007625	121.0616469	1587694.	10.0000563	0.0007625	0.00003355	2.9509382	13.3397116
0.00007875	124.9918275	1587198.	9.8411511	0.0007750	0.00002214	2.9883061	13.4141792
0.00008125	128.9182325	1586686.	9.6922393	0.0007875	0.00001074	3.0253822	13.4891528
0.00008375	132.8407403	1586158.	9.5524263	0.0008000	-6.34301E-07	3.0621649	13.5646328
0.00008625	136.7591531	1585613.	9.4209203	0.0008126	-0.00001200	3.0986527	13.6406180
0.00008875	140.6728719	1585046.	9.2970160	0.0008251	-0.00002334	3.1348434	13.7170995
0.00009125	144.5810153	1584449.	9.1800829	0.0008377	-0.00003467	3.1707338	13.7940623
0.00009375	148.4826465	1583815.	9.0695570	0.0008503	-0.00004598	3.2063211	13.8714897
0.00009625	152.3768266	1583136.	8.9649331	0.0008629	-0.00005728	3.2416023	13.9493645
0.00009875	156.2626488	1582407.	8.8657567	0.0008755	-0.00006856	3.2765742	14.0276694
0.0001013	160.1392559	1581622.	8.7716188	0.0008881	-0.00007982	3.3112342	14.1063877
0.0001038	164.0058489	1580779.	8.6821497	0.0009008	-0.00009108	3.3455795	14.1855035
0.0001063	167.8616883	1579875.	8.5970151	0.0009134	-0.000102	3.3796075	14.2650018
0.0001088	167.8616883	1543556.	8.4889185	0.0009232	-0.000116	3.4054648	14.2597371 C
0.0001113	170.7782945	1535086.	8.4061313	0.0009352	-0.000128	3.4371520	14.3204573 C
0.0001138	173.6845261	1526897.	8.3265136	0.0009471	-0.000140	3.4683807	14.3796263 C
0.0001163	176.5150454	1518409.	8.2498880	0.0009590	-0.000152	3.4991638	14.4373380 C
0.0001188	179.2726215	1509664.	8.1760749	0.0009709	-0.000164	3.5295080	14.4936246 C
0.0001213	181.9374595	1500515.	8.1047251	0.0009827	-0.000176	3.5593631	14.5478698 C
0.0001238	184.5391827	1491226.	8.0359057	0.0009944	-0.000189	3.5888022	14.6008502 C
0.0001263	187.0840787	1481854.	7.9695093	0.0010062	-0.000201	3.6178422	14.6527232 C
0.0001288	189.5533217	1472259.	7.9052345	0.0010178	-0.000213	3.6464351	14.7028898 C
0.0001313	191.9561431	1462523.	7.8430154	0.0010294	-0.000225	3.6746033	14.7515615 C
0.0001338	194.3166251	1452835.	7.7829235	0.0010410	-0.000238	3.7024111	14.7994621 C
0.0001363	196.5992673	1442930.	7.7245475	0.0010525	-0.000250	3.7297647	14.8454295 C
0.0001388	198.8359332	1433052.	7.6680349	0.0010639	-0.000263	3.7567482	14.8904302 C
0.0001413	201.0254930	1423189.	7.6132762	0.0010754	-0.000275	3.7833605	14.9344207 C
0.0001438	203.1488401	1413209.	7.5600110	0.0010868	-0.000287	3.8095479	14.9766945 C
0.0001463	205.2473754	1403401.	7.5084944	0.0010981	-0.000300	3.8354266	15.0186669 C
0.0001488	207.2681640	1393399.	7.4581978	0.0011094	-0.000313	3.8608485	15.0584295 C
0.0001588	214.9784599	1354195.	7.2710418	0.0011543	-0.000363	3.9591084	15.2091388 C
0.0001688	222.0728024	1315987.	7.1029655	0.0011986	-0.000415	4.0518569	15.3446702 C
0.0001788	228.6208927	1278998.	6.9509926	0.0012425	-0.000466	4.1393282	15.4661951 C
0.0001888	234.6987317	1243437.	6.8128887	0.0012859	-0.000519	4.2217785	15.5754922 C
0.0001988	240.3590831	1209354.	6.6867660	0.0013290	-0.000571	4.2994024	15.6737457 C
0.0002088	245.6668309	1176847.	6.5712484	0.0013717	-0.000624	4.3724305	15.7630458 C
0.0002188	250.6507114	1145832.	6.4649737	0.0014142	-0.000677	4.4409830	15.8439835 C

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0.0002288	255.3388935	1116236.	6.3668335	0.0014564	-0.000730	4.5051769	15.9172427	C
0.0002388	259.7588755	1087995.	6.2759214	0.0014984	-0.000784	4.5651253	15.9836256	C
0.0002488	263.9372746	1061054.	6.1914931	0.0015401	-0.000838	4.6209360	16.0440518	C
0.0002588	267.8996632	1035361.	6.1129363	0.0015817	-0.000892	4.6727099	16.0995689	C
0.0002688	271.6703990	1010867.	6.0397481	0.0016232	-0.000946	4.7205400	16.1513636	C
0.0002788	275.2724545	987525.	5.9715159	0.0016646	-0.001000	4.7645091	16.2007728	C
0.0002888	278.6664763	965079.	5.9073056	0.0017057	-0.001055	4.8045265	16.2442853	C
0.0002988	281.9171625	943656.	5.8472431	0.0017469	-0.001109	4.8407818	16.2864909	C
0.0003088	285.0352810	923191.	5.7910212	0.0017880	-0.001164	4.8733099	16.3282493	C
0.0003188	287.9774012	903459.	5.7378179	0.0018289	-0.001218	4.9020175	16.3653013	C
0.0003288	290.8311506	884657.	5.6881832	0.0018700	-0.001273	4.9271044	16.4055182	C
0.0003388	293.5045922	866434.	5.6408783	0.0019108	-0.001328	4.9483901	16.4398333	C
0.0003488	296.1053413	849048.	5.5967475	0.0019519	-0.001382	4.9660727	16.4788146	C
0.0003588	298.5502479	832196.	5.5546766	0.0019927	-0.001437	4.9800170	16.5136297	C
0.0003688	300.9129831	816035.	5.5152416	0.0020337	-0.001492	4.9903193	16.5522317	C
0.0003788	303.1625030	800429.	5.4779052	0.0020748	-0.001546	4.9969293	16.5910128	C
0.0003888	305.3011325	785341.	5.4425317	0.0021158	-0.001601	4.9998458	16.6302677	C
0.0003988	307.3584831	770805.	5.4093808	0.0021570	-0.001655	4.9999068	16.6747064	C
0.0004088	309.2811363	756651.	5.3777889	0.0021982	-0.001709	4.9999200	16.7183984	C
0.0004188	311.0992093	742923.	5.3479990	0.0022395	-0.001764	4.9998974	16.7656500	C
0.0004288	312.8285992	729629.	5.3200568	0.0022810	-0.001818	4.9998274	16.8185929	C
0.0004388	314.4485213	716692.	5.2935525	0.0023225	-0.001872	4.9996727	16.8736327	C
0.0004488	315.9595869	704088.	5.2683408	0.0023642	-0.001926	4.9993738	16.9301193	C
0.0004588	317.3913957	691861.	5.2446399	0.0024060	-0.001980	4.9988588	16.9920816	C
0.0004688	318.7473955	679994.	5.2223433	0.0024480	-0.002033	4.9986851	17.0593861	C
0.0004788	320.0096192	668427.	5.2011604	0.0024901	-0.002087	4.9999300	17.1292200	C
0.0004888	321.1796876	657145.	5.1809347	0.0025322	-0.002140	4.9995222	17.2003366	C
0.0004988	322.2850751	646186.	5.1618636	0.0025745	-0.002194	4.9986165	17.2764219	C
0.0005088	323.3277494	635534.	5.1438735	0.0026169	-0.002247	4.9999921	17.3573952	C
0.0005188	324.3015593	625160.	5.1269304	0.0026596	-0.002300	4.9995666	17.4436819	C
0.0005288	325.2144159	615063.	5.1108283	0.0027024	-0.002352	4.9983405	17.5330396	C
0.0005388	326.0517217	605200.	5.0953212	0.0027451	-0.002405	4.9999348	17.6223554	C
0.0005488	326.8312097	595592.	5.0806860	0.0027880	-0.002458	4.9990476	17.7165533	C
0.0006088	330.4953441	542908.	5.0077639	0.0030485	-0.002771	4.9995192	18.3663235	C
0.0006688	332.6352274	497398.	4.9539579	0.0033130	-0.003080	4.9979560	19.1330564	C
0.0007288	333.6234739	457802.	4.9146927	0.0035816	-0.003385	4.9992858	20.0198486	C
0.0007888	333.6234739	422977.	4.8913393	0.0038580	-0.003682	4.9994116	21.1339599	C

Axial Thrust Force = 186.610 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	1.8416865	1473349.	426.8480636	0.0005336	0.0005216	2.2097596	15.3294241	
0.00000250	3.6770431	1470817.	215.8167758	0.0005395	0.0005156	2.2306977	15.3590798	
0.00000375	5.5123681	1469965.	145.4742415	0.0005455	0.0005097	2.2515731	15.3888690	
0.00000500	7.3476456	1469529.	110.3038955	0.0005515	0.0005037	2.2723856	15.4187919	
0.00000625	9.1828596	1469258.	89.2024250	0.0005575	0.0004978	2.2931351	15.4488483	
0.00000750	11.0179942	1469066.	75.1353921	0.0005635	0.0004918	2.3138214	15.4790383	
0.00000875	12.8530335	1468918.	65.0880379	0.0005695	0.0004859	2.3344443	15.5093619	
0.00001000	14.6879616	1468796.	57.5529830	0.0005755	0.0004799	2.3550036	15.5398191	
0.00001125	16.5227625	1468690.	51.6927942	0.0005815	0.0004740	2.3754991	15.5704099	
0.00001250	18.3574205	1468594.	47.0050118	0.0005876	0.0004681	2.3959307	15.6011343	
0.00001375	20.1919194	1468503.	43.1698885	0.0005936	0.0004621	2.4162982	15.6319923	
0.00001500	22.0262435	1468416.	39.9742596	0.0005996	0.0004562	2.4366013	15.6629840	
0.00001625	23.8603768	1468331.	37.2705496	0.0006056	0.0004503	2.4568400	15.6941093	
0.00001750	25.6943034	1468246.	34.9533472	0.0006117	0.0004444	2.4770139	15.7253682	
0.00001875	27.5280073	1468160.	32.9453509	0.0006177	0.0004385	2.4971230	15.7567608	
0.00002000	29.3614727	1468074.	31.1885846	0.0006238	0.0004326	2.5171670	15.7882871	
0.00002125	31.1946835	1467985.	29.6387137	0.0006298	0.0004267	2.5371458	15.8199471	
0.00002250	33.0276240	1467894.	28.2612555	0.0006359	0.0004208	2.5570591	15.8517408	
0.00002375	34.8602780	1467801.	27.0289871	0.0006419	0.0004149	2.5769069	15.8836682	
0.00002500	36.6926297	1467705.	25.9201301	0.0006480	0.0004090	2.5966888	15.9157293	
0.00002625	38.5246632	1467606.	24.9170541	0.0006541	0.0004031	2.6164048	15.9479242	
0.00002750	40.3563624	1467504.	24.0053346	0.0006601	0.0003972	2.6360546	15.9802529	
0.00002875	42.1877114	1467399.	23.1730556	0.0006662	0.0003914	2.6556380	16.0127154	
0.00003000	44.0186944	1467290.	22.4102870	0.0006723	0.0003855	2.6751549	16.0453117	

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0.00003125	45.8492952	1467177.	21.7086875	0.0006784	0.0003796	2.6946051	16.0780418
0.00003250	47.6794980	1467061.	21.0611992	0.0006845	0.0003738	2.7139884	16.1109058
0.00003375	49.5092868	1466942.	20.4618099	0.0006906	0.0003679	2.7333046	16.1439037
0.00003500	51.3386456	1466818.	19.9053660	0.0006967	0.0003621	2.7525536	16.1770355
0.00003625	53.1675584	1466691.	19.3874249	0.0007028	0.0003562	2.7717350	16.2103012
0.00003750	54.9960093	1466560.	18.9041364	0.0007089	0.0003504	2.7908488	16.2437009
0.00003875	56.8239822	1466425.	18.4521471	0.0007150	0.0003446	2.8098948	16.2772346
0.00004000	58.6514612	1466287.	18.0285226	0.0007211	0.0003387	2.8288728	16.3109023
0.00004125	60.4784302	1466144.	17.6306844	0.0007273	0.0003329	2.8477826	16.3447041
0.00004250	62.3048733	1465997.	17.2563573	0.0007334	0.0003271	2.8666240	16.3786399
0.00004375	64.1307744	1465846.	16.9035259	0.0007395	0.0003213	2.8853968	16.4127098
0.00004500	65.9561176	1465692.	16.5703991	0.0007457	0.0003155	2.9041008	16.4469139
0.00004625	67.7808868	1465533.	16.2553792	0.0007518	0.0003097	2.9227359	16.4812522
0.00004750	69.6050659	1465370.	15.9570367	0.0007580	0.0003039	2.9413019	16.5157246
0.00004875	71.4286389	1465203.	15.6740888	0.0007641	0.0002981	2.9597985	16.5503313
0.00005125	75.0739026	1464857.	15.1498710	0.0007764	0.0002865	2.9965831	16.6199476
0.00005375	78.7165493	1464494.	14.6747624	0.0007888	0.0002749	3.0330881	16.6901013
0.00005625	82.3564505	1464115.	14.2422154	0.0008011	0.0002634	3.0693122	16.7607927
0.00005875	85.9934774	1463719.	13.8467966	0.0008135	0.0002518	3.1052537	16.8320222
0.00006125	89.6275013	1463306.	13.4839601	0.0008259	0.0002403	3.1409112	16.9037900
0.00006375	93.2583931	1462877.	13.1498727	0.0008383	0.0002289	3.1762832	16.9760966
0.00006625	96.8860237	1462431.	12.8412801	0.0008507	0.0002174	3.2113682	17.0489424
0.00006875	100.5102638	1461967.	12.5554012	0.0008632	0.0002059	3.2461646	17.1223276
0.00007125	104.1309840	1461487.	12.2898453	0.0008757	0.0001945	3.2806711	17.1962528
0.00007375	107.7480548	1460991.	12.0425458	0.0008881	0.0001831	3.3148859	17.2707184
0.00007625	111.3613462	1460477.	11.8117073	0.0009006	0.0001717	3.3488078	17.3457247
0.00007875	114.9707283	1459946.	11.5957622	0.0009132	0.0001603	3.3824350	17.4212723
0.00008125	118.5760711	1459398.	11.3933358	0.0009257	0.0001490	3.4157662	17.4973616
0.00008375	122.1772442	1458833.	11.2032179	0.0009383	0.0001376	3.4487997	17.5739930
0.00008625	125.7741170	1458251.	11.0243383	0.0009508	0.0001263	3.4815341	17.6511672
0.00008875	129.3665588	1457651.	10.8557475	0.0009634	0.0001150	3.5139679	17.7288845
0.00009125	132.9544387	1457035.	10.6966000	0.0009761	0.0001037	3.5460994	17.8071456
0.00009375	136.5376255	1456401.	10.5461405	0.0009887	0.00009245	3.5779273	17.8859510
0.00009625	140.1159879	1455751.	10.4036923	0.0010014	0.00008121	3.6094498	17.9653013
0.00009875	143.6893942	1455082.	10.2686472	0.0010140	0.00006998	3.6406656	18.0451969
0.0001013	147.2577126	1454397.	10.1404569	0.0010267	0.00005877	3.6715731	18.1256386
0.0001038	150.8208110	1453695.	10.0186261	0.0010394	0.00004758	3.7021706	18.2066269
0.0001063	154.3785570	1452975.	9.9027062	0.0010522	0.00003641	3.7324567	18.2881626
0.0001088	157.9308181	1452237.	9.7922897	0.0010649	0.00002526	3.7624298	18.3702461
0.0001113	161.4774613	1451483.	9.6870057	0.0010777	0.00001413	3.7920884	18.4528782
0.0001138	165.0183536	1450711.	9.5865161	0.0010905	0.00000302	3.8214308	18.5360595
0.0001163	168.5533539	1449921.	9.4905117	0.0011033	-0.00000808	3.8504556	18.6197907
0.0001188	172.0821245	1449113.	9.3987082	0.0011161	-0.00001915	3.8791608	18.7040680
0.0001213	175.6041239	1448281.	9.3108434	0.0011289	-0.00003021	3.9075442	18.7888832
0.0001238	179.1187164	1447424.	9.2266756	0.0011418	-0.00004125	3.9356033	18.8742258
0.0001263	182.6252445	1446537.	9.1459822	0.0011547	-0.00005227	3.9633358	18.9600844
0.0001288	186.1230534	1445616.	9.0685576	0.0011676	-0.00006327	3.9907393	19.0464474
0.0001313	189.6114910	1444659.	8.9942118	0.0011805	-0.00007426	4.0178115	19.1333028
0.0001338	193.0899147	1443663.	8.9227692	0.0011934	-0.00008523	4.0445499	19.2206387
0.0001363	196.5576989	1442625.	8.8540669	0.0012064	-0.00009618	4.0709523	19.3084430
0.0001388	200.0143149	1441545.	8.7879543	0.0012193	-0.000107	4.0970167	19.3967059
0.0001413	200.5908706	1420112.	8.7077824	0.0012300	-0.000120	4.1181032	19.4177916 C
0.0001438	203.4396559	1415232.	8.6432506	0.0012425	-0.000132	4.1425721	19.4924526 C
0.0001463	206.2077381	1409967.	8.5805690	0.0012549	-0.000143	4.1665959	19.5656033 C
0.0001488	208.9174850	1404487.	8.5197746	0.0012673	-0.000155	4.1902160	19.6378061 C
0.0001588	219.1834301	1380683.	8.2936372	0.0013166	-0.000201	4.2806992	19.9169151 C
0.0001688	228.5854895	1354581.	8.0911553	0.0013654	-0.000248	4.3649266	20.1806281 C
0.0001788	237.2059832	1327026.	7.9085041	0.0014136	-0.000295	4.4431121	20.4296989 C
0.0001888	245.1386185	1298748.	7.7428040	0.0014615	-0.000343	4.5154944	20.6656170 C
0.0001988	252.4831441	1270355.	7.5918831	0.0015089	-0.000391	4.5823236	20.8906126 C
0.0002088	259.2486580	1241910.	7.4534540	0.0015559	-0.000440	4.6436760	21.1036976 C
0.0002188	265.5529615	1213956.	7.3263799	0.0016026	-0.000489	4.6998269	21.3085291 C
0.0002288	271.4050418	1186470.	7.2090826	0.0016491	-0.000538	4.7508435	21.5045122 C
0.0002388	276.8416669	1159546.	7.1004330	0.0016952	-0.000587	4.7968431	21.6923375 C
0.0002488	281.9189494	1133343.	6.9996477	0.0017412	-0.000637	4.8379674	21.8738745 C
0.0002588	286.6647645	1107883.	6.9059115	0.0017869	-0.000687	4.8743019	22.0498563 C
0.0002688	291.1064571	1083187.	6.8185470	0.0018325	-0.000737	4.9059240	22.2211276 C
0.0002788	295.2706640	1059267.	6.7369909	0.0018779	-0.000787	4.9329020	22.3886813 C
0.0002888	299.1428954	1035993.	6.6604609	0.0019232	-0.000837	4.9552516	22.5510197 C

0.0002988	302.7686295	1013451.	6.5887134	0.0019684	-0.000888	4.9730543	22.7104051 C
0.0003088	306.1790774	991673.	6.5214799	0.0020135	-0.000938	4.9863558	22.8685940 C
0.0003188	309.3835140	970615.	6.4583877	0.0020586	-0.000989	4.9951709	23.0260672 C
0.0003288	312.3397044	950083.	6.3986779	0.0021036	-0.001039	4.9995012	23.1791962 C
0.0003388	315.1313121	930277.	6.3427384	0.0021486	-0.001090	4.9999112	23.3347317 C
0.0003488	317.6936588	910950.	6.2898572	0.0021936	-0.001140	4.9994139	23.4887520 C
0.0003588	320.0671936	892173.	6.2401464	0.0022387	-0.001191	4.9993199	23.6450859 C
0.0003688	322.2439639	873882.	6.1932014	0.0022837	-0.001242	4.9995916	23.8021652 C
0.0003788	324.2543689	856117.	6.1489807	0.0023289	-0.001292	4.9997353	23.9619385 C
0.0003888	326.0804376	838792.	6.1070475	0.0023741	-0.001342	4.9997941	24.1218518 C
0.0003988	327.7883787	822040.	6.0677348	0.0024195	-0.001393	4.9997972	24.2877473 C
0.0004088	329.3006350	805628.	6.0300519	0.0024648	-0.001443	4.9997348	24.4501612 C
0.0004188	330.7148915	789767.	5.9946958	0.0025103	-0.001493	4.9995951	24.6189748 C
0.0004288	332.0012089	774347.	5.9611368	0.0025558	-0.001543	4.9993282	24.7896259 C
0.0004388	333.1524267	759322.	5.9290907	0.0026014	-0.001593	4.9988608	24.9600629 C
0.0004488	334.2235654	744788.	5.8989141	0.0026471	-0.001643	4.9991279	25.1362409 C
0.0004588	335.1895568	730658.	5.8702541	0.0026930	-0.001693	4.9999281	25.3150930 C
0.0004688	336.0349925	716875.	5.8427124	0.0027388	-0.001742	4.9995537	25.4925290 C
0.0004788	336.8154131	703531.	5.8166912	0.0027847	-0.001792	4.9987319	25.6750977 C
0.0004888	337.5334691	690606.	5.7920880	0.0028309	-0.001842	4.9999942	25.8626736 C
0.0004988	338.1451931	677985.	5.7684137	0.0028770	-0.001891	4.9996091	26.0494128 C
0.0005088	338.6850959	665720.	5.7457449	0.0029231	-0.001941	4.9984688	26.2372570 C
0.0005188	339.1715073	653825.	5.7242596	0.0029695	-0.001990	4.9999397	26.4297581 C
0.0005288	339.6022400	642274.	5.7039038	0.0030159	-0.002039	4.9991108	26.6271169 C
0.0005388	339.9835569	631060.	5.6844372	0.0030625	-0.002088	4.9996707	26.8265616 C
0.0005488	340.2715708	620085.	5.6655350	0.0031090	-0.002137	4.9994088	27.0236973 C
0.0006088	341.1432587	560400.	5.5690307	0.0033901	-0.002430	4.9991067	28.2747905 C
0.0006688	341.1432587	510121.	5.4944657	0.0036744	-0.002719	4.9999992	29.6155316 C
0.0007288	341.1432587	468121.	5.4526113	0.0039736	-0.002993	4.9970520	31.3880865 C

Summary of Results for Nominal Moment Capacity for Section 2

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	142.140	329.813	0.00300000	-0.00271289
2	186.610	339.455	0.00300000	-0.00202207

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	142.140000	329.813356	92.391000	214.378681	1357245.
2	0.65	186.610000	339.454529	121.296500	220.645444	1376624.
1	0.75	142.140000	329.813356	106.605000	247.360017	1166310.
2	0.75	186.610000	339.454529	139.957500	254.590897	1261493.
1	0.90	142.140000	329.813356	127.926000	296.832021	844039.

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2 0.90 186.610000 339.454529 167.949000 305.509076 995952.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	-3.500	0.00	N.A.	No	0.00	67676.
2	8.0000	11.5000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 39560.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 186610.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5536	-2008742.	39560.	0.00	0.00	8.05E+09	-112.922	195.8120	0.00
0.1600	0.5532	-1932909.	39335.	-4.70E-04	0.00	8.05E+09	-121.406	421.3997	0.00
0.3200	0.5518	-1857358.	39093.	-9.21E-04	0.00	8.09E+09	-130.402	453.7258	0.00
0.4800	0.5496	-1782130.	38834.	-0.00135	0.00	8.11E+09	-139.671	487.9164	0.00
0.6400	0.5466	-1707266.	38557.	-0.00177	0.00	8.13E+09	-149.210	524.1033	0.00
0.8000	0.5428	-1632808.	38261.	-0.00216	0.00	8.15E+09	-159.015	562.4294	0.00
0.9600	0.5383	-1558797.	37946.	-0.00253	0.00	8.17E+09	-169.082	603.0502	0.00
1.1200	0.5331	-1485279.	37611.	-0.00289	0.00	8.20E+09	-180.049	648.4514	0.00
1.2800	0.5272	-1412300.	37254.	-0.00323	0.00	8.22E+09	-191.443	697.1875	0.00
1.4400	0.5207	-1339908.	36875.	-0.00355	0.00	8.25E+09	-203.183	749.2061	0.00
1.6000	0.5136	-1268154.	36473.	-0.00385	0.00	8.28E+09	-215.268	804.7702	0.00
1.7600	0.5059	-1197088.	36048.	-0.00414	0.00	8.32E+09	-227.699	864.1687	0.00
1.9200	0.4977	-1126762.	35599.	-0.00441	0.00	8.35E+09	-240.475	927.7181	0.00
2.0800	0.4890	-1057230.	35124.	-0.00466	0.00	8.39E+09	-253.596	995.7669	0.00
2.2400	0.4798	-988547.	34625.	-0.00489	0.00	8.43E+09	-267.063	1069.	0.00
2.4000	0.4702	-920767.	34099.	-0.00511	0.00	8.48E+09	-280.875	1147.	0.00
2.5600	0.4602	-853947.	33546.	-0.00531	0.00	8.52E+09	-295.032	1231.	0.00
2.7200	0.4498	-788147.	32965.	-0.00549	0.00	8.58E+09	-309.535	1321.	0.00
2.8800	0.4391	-723424.	32357.	-0.00566	0.00	8.63E+09	-324.384	1418.	0.00
3.0400	0.4281	-659840.	31719.	-0.00581	0.00	8.69E+09	-339.577	1523.	0.00
3.2000	0.4168	-597455.	31053.	-0.00595	0.00	8.75E+09	-355.116	1636.	0.00
3.3600	0.4052	-536332.	30355.	-0.00608	0.00	8.82E+09	-371.001	1758.	0.00
3.5200	0.3934	-476535.	29634.	-0.00619	0.00	8.89E+09	-380.936	1859.	0.00
3.6800	0.3814	-418105.	28894.	-0.00628	0.00	8.89E+09	-389.143	1959.	0.00
3.8400	0.3693	-361078.	28140.	-0.00637	0.00	8.89E+09	-396.889	2063.	0.00
4.0000	0.3570	-305486.	27371.	-0.00644	0.00	8.89E+09	-404.155	2174.	0.00

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4.1600	0.3446	-251360.	26588.	-0.00650	0.00	8.89E+09	-410.925	2290.	0.00
4.3200	0.3320	-198729.	25793.	-0.00655	0.00	8.89E+09	-417.183	2412.	0.00
4.4800	0.3194	-147621.	24987.	-0.00659	0.00	8.89E+09	-422.917	2542.	0.00
4.6400	0.3067	-98060.	24170.	-0.00661	0.00	8.89E+09	-428.115	2680.	0.00
4.8000	0.2940	-50070.	23343.	-0.00663	0.00	8.89E+09	-432.768	2826.	0.00
4.9600	0.2813	-3672.	22508.	-0.00663	0.00	8.89E+09	-436.868	2982.	0.00
5.1200	0.2685	41116.	21666.	-0.00663	0.00	8.89E+09	-440.410	3149.	0.00
5.2800	0.2558	84278.	20818.	-0.00662	0.00	8.89E+09	-443.388	3328.	0.00
5.4400	0.2431	125798.	19964.	-0.00659	0.00	8.89E+09	-445.802	3520.	0.00
5.6000	0.2305	165666.	19106.	-0.00656	0.00	8.89E+09	-447.650	3729.	0.00
5.7600	0.2179	203870.	18246.	-0.00652	0.00	8.89E+09	-448.935	3955.	0.00
5.9200	0.2055	240404.	17383.	-0.00647	0.00	8.89E+09	-449.660	4202.	0.00
6.0800	0.1931	275261.	16520.	-0.00642	0.00	8.89E+09	-449.829	4473.	0.00
6.2400	0.1808	308439.	15656.	-0.00636	0.00	8.89E+09	-449.450	4773.	0.00
6.4000	0.1687	339936.	14794.	-0.00629	0.00	8.89E+09	-448.327	5103.	0.00
6.5600	0.1567	369754.	13936.	-0.00621	0.00	8.89E+09	-446.081	5467.	0.00
6.7200	0.1448	397899.	13083.	-0.00613	0.00	8.89E+09	-442.617	5868.	0.00
6.8800	0.1331	424381.	12237.	-0.00604	0.00	8.89E+09	-437.834	6314.	0.00
7.0400	0.1216	449217.	11403.	-0.00594	0.00	8.89E+09	-431.614	6813.	0.00
7.2000	0.1103	472427.	10582.	-0.00584	0.00	8.89E+09	-423.818	7376.	0.00
7.3600	0.09920	494038.	9777.	-0.00574	0.00	8.89E+09	-414.279	8018.	0.00
7.5200	0.08828	514083.	8993.	-0.00563	0.00	8.89E+09	-402.794	8760.	0.00
7.6800	0.07758	532604.	8232.	-0.00552	0.00	8.83E+09	-389.106	9630.	0.00
7.8400	0.06709	549649.	7501.	-0.00540	0.00	8.79E+09	-372.884	10671.	0.00
8.0000	0.05684	565276.	4211.	-0.00528	0.00	8.78E+09	-3054.	103154.	0.00
8.1600	0.04683	569601.	-3106.	-0.00515	0.00	8.78E+09	-4568.	187273.	0.00
8.3200	0.03705	557043.	-11238.	-0.00503	0.00	8.79E+09	-3903.	202259.	0.00
8.4800	0.02751	530052.	-18001.	-0.00491	0.00	8.85E+09	-3142.	219246.	0.00
8.6400	0.01819	491438.	-23189.	-0.00480	0.00	8.89E+09	-2262.	238668.	0.00
8.8000	0.00908	444449.	-26545.	-0.00470	0.00	8.89E+09	-1234.	261110.	0.00
8.9600	1.45E-04	392874.	-27750.	-0.00461	0.00	8.89E+09	-21.681	287374.	0.00
9.1200	-0.00862	341190.	-27061.	-0.00294	0.00	2.01E+08	739.5511	164645.	0.00
9.2800	-0.01113	291064.	-25451.	-0.00105	0.00	1.08E+09	937.9998	161775.	0.00
9.4400	-0.01265	244210.	-23538.	-6.10E-04	0.00	1.30E+09	1055.	160119.	0.00
9.6000	-0.01348	201116.	-21452.	-2.94E-04	0.00	1.42E+09	1118.	159263.	0.00
9.7600	-0.01378	162046.	-19283.	-5.09E-05	0.00	1.45E+09	1141.	158988.	0.00
9.9200	-0.01367	127105.	-17100.	1.40E-04	0.00	1.46E+09	1133.	159162.	0.00
10.0800	-0.01324	96282.	-14955.	2.87E-04	0.00	1.46E+09	1101.	159684.	0.00
10.2400	-0.01257	69473.	-12889.	3.96E-04	0.00	1.47E+09	1051.	160470.	0.00
10.4000	-0.01172	46505.	-10934.	4.72E-04	0.00	1.47E+09	985.7739	161451.	0.00
10.5600	-0.01076	27149.	-9113.	5.20E-04	0.00	1.47E+09	910.9869	162567.	0.00
10.7200	-0.00973	11139.	-7442.	5.45E-04	0.00	1.47E+09	829.6936	163767.	0.00
10.8800	-0.00867	-1819.	-5930.	5.51E-04	0.00	1.47E+09	744.8930	165008.	0.00
11.0400	-0.00761	-12029.	-4583.	5.42E-04	0.00	1.47E+09	659.1345	166253.	0.00
11.2000	-0.00659	-19804.	-3398.	5.21E-04	0.00	1.47E+09	574.5534	167473.	0.00
11.3600	-0.00561	-25451.	-2373.	4.91E-04	0.00	1.47E+09	492.8931	168643.	0.00
11.5200	-0.00470	-29270.	-1501.	4.56E-04	0.00	1.47E+09	415.5288	169745.	0.00
11.6800	-0.00386	-31543.	-772.729	4.16E-04	0.00	1.47E+09	343.4939	170766.	0.00
11.8400	-0.00310	-32535.	-176.566	3.74E-04	0.00	1.47E+09	277.5088	171695.	0.00
12.0000	-0.00243	-32489.	299.1351	3.31E-04	0.00	1.47E+09	218.0138	172529.	0.00
12.1600	-0.00183	-31624.	667.0248	2.89E-04	0.00	1.47E+09	165.2047	173266.	0.00
12.3200	-0.00131	-30135.	939.9285	2.49E-04	0.00	1.47E+09	119.0700	173905.	0.00
12.4800	-8.74E-04	-28193.	1130.	2.11E-04	0.00	1.47E+09	79.4284	174452.	0.00
12.6400	-5.05E-04	-25945.	1251.	1.76E-04	0.00	1.47E+09	45.9651	174912.	0.00
12.8000	-2.00E-04	-23516.	1313.	1.43E-04	0.00	1.47E+09	18.2667	175290.	0.00
12.9600	4.54E-05	-21008.	1326.	1.14E-04	0.00	1.47E+09	-4.146	175482.	0.00
13.1200	2.38E-04	-18505.	1301.	8.83E-05	0.00	1.47E+09	-21.728	175245.	0.00
13.2800	3.84E-04	-16074.	1247.	6.57E-05	0.00	1.47E+09	-35.041	175067.	0.00
13.4400	4.90E-04	-13765.	1170.	4.62E-05	0.00	1.47E+09	-44.665	174939.	0.00
13.6000	5.62E-04	-11614.	1078.	2.96E-05	0.00	1.47E+09	-51.142	174854.	0.00
13.7600	6.04E-04	-9646.	976.3848	1.57E-05	0.00	1.47E+09	-54.971	174805.	0.00
13.9200	6.22E-04	-7876.	869.2729	4.23E-06	0.00	1.47E+09	-56.604	174786.	0.00
14.0800	6.20E-04	-6311.	760.7444	-5.03E-06	0.00	1.47E+09	-56.446	174790.	0.00
14.2400	6.02E-04	-4951.	653.8963	-1.24E-05	0.00	1.47E+09	-54.854	174814.	0.00
14.4000	5.72E-04	-3791.	551.1879	-1.81E-05	0.00	1.47E+09	-52.134	174852.	0.00
14.5600	5.33E-04	-2821.	454.5296	-2.24E-05	0.00	1.47E+09	-48.551	174901.	0.00
14.7200	4.86E-04	-2029.	365.3687	-2.56E-05	0.00	1.47E+09	-44.325	174958.	0.00
14.8800	4.35E-04	-1400.	284.7693	-2.78E-05	0.00	1.47E+09	-39.633	175021.	0.00
15.0400	3.80E-04	-916.012	213.4865	-2.93E-05	0.00	1.47E+09	-34.620	175087.	0.00

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15.2000	3.22E-04	-559.211	152.0334	-3.03E-05	0.00	1.47E+09	-29.394	175156.	0.00
15.3600	2.63E-04	-310.507	100.7405	-3.08E-05	0.00	1.47E+09	-24.036	175227.	0.00
15.5200	2.04E-04	-150.265	59.8063	-3.11E-05	0.00	1.47E+09	-18.604	175298.	0.00
15.6800	1.44E-04	-58.533	29.3402	-3.13E-05	0.00	1.47E+09	-13.132	175369.	0.00
15.8400	8.36E-05	-15.183	9.3966	-3.13E-05	0.00	1.47E+09	-7.643	175440.	0.00
16.0000	2.35E-05	0.00	0.00	-3.13E-05	0.00	1.47E+09	-2.145	87755.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

* WARNING: Some values of computed curvature exceeded the maximum curvature calculated or entered by the user
Depth = 9.1200 ft Computed Curv. = 0.00170 rad/in Maximum Curv. = 7.29E-04 rad/in

Output Summary for Load Case No. 1:

Pile-head deflection = 0.55361693 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -2008742. inch-lbs
Maximum shear force = 39560. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 0.000000 feet below pile head
Number of iterations = 35
Number of zero deflection points = 3

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

Shear = 39560. lbs
Slope = 0.000000
Axial Load = 186610. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
16.00000	0.55361693	-2008742.	39560.
15.20000	0.55279154	-2007922.	39560.
14.40000	0.56233309	-2023048.	39560.
13.60000	0.55060015	-2005919.	39560.
12.80000	0.56170200	-2021501.	39560.
12.00000	0.55357656	-2009884.	39560.
11.20000	0.56467631	-2025407.	39560.
10.40000	0.55430347	-2004476.	39560.
9.60000	0.69139999	-2227101.	39560.
8.80000	0.80016076	-2450534.	39560.
8.00000	0.87000906	-2475248.	39560.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 29590.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 142140.0 lbs

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(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.3415	-1378836.	29590.	0.00	0.00	8.16E+09	-101.231	284.6102	0.00
0.1600	0.3411	-1322165.	29389.	-3.18E-04	0.00	8.16E+09	-108.378	609.9674	0.00
0.3200	0.3402	-1265809.	29173.	-6.22E-04	0.00	8.19E+09	-116.292	656.2594	0.00
0.4800	0.3388	-1209801.	28942.	-9.12E-04	0.00	8.22E+09	-124.303	704.5239	0.00
0.6400	0.3367	-1154174.	28696.	-0.00119	0.00	8.24E+09	-132.386	754.8468	0.00
0.8000	0.3342	-1098962.	28434.	-0.00145	0.00	8.26E+09	-140.523	807.3252	0.00
0.9600	0.3312	-1044198.	28156.	-0.00170	0.00	8.29E+09	-148.692	862.0693	0.00
1.1200	0.3277	-989916.	27862.	-0.00193	0.00	8.32E+09	-157.301	921.7025	0.00
1.2800	0.3237	-936151.	27552.	-0.00216	0.00	8.35E+09	-165.996	984.4600	0.00
1.4400	0.3194	-882940.	27225.	-0.00236	0.00	8.38E+09	-174.697	1050.	0.00
1.6000	0.3147	-830317.	26881.	-0.00256	0.00	8.42E+09	-183.382	1119.	0.00
1.7600	0.3096	-778319.	26521.	-0.00274	0.00	8.46E+09	-192.029	1191.	0.00
1.9200	0.3041	-726981.	26144.	-0.00291	0.00	8.50E+09	-200.615	1266.	0.00
2.0800	0.2984	-676337.	25750.	-0.00307	0.00	8.55E+09	-209.119	1346.	0.00
2.2400	0.2923	-626423.	25341.	-0.00322	0.00	8.59E+09	-217.522	1429.	0.00
2.4000	0.2860	-577272.	24915.	-0.00335	0.00	8.65E+09	-225.804	1516.	0.00
2.5600	0.2795	-528919.	24474.	-0.00347	0.00	8.70E+09	-233.946	1607.	0.00
2.7200	0.2727	-481396.	24017.	-0.00358	0.00	8.76E+09	-241.931	1703.	0.00
2.8800	0.2657	-434737.	23545.	-0.00368	0.00	8.93E+09	-249.743	1805.	0.00
3.0400	0.2585	-388972.	23058.	-0.00377	0.00	8.93E+09	-257.367	1911.	0.00
3.2000	0.2512	-344134.	22557.	-0.00385	0.00	8.93E+09	-264.790	2024.	0.00
3.3600	0.2438	-300251.	22042.	-0.00392	0.00	8.93E+09	-271.996	2142.	0.00
3.5200	0.2362	-257354.	21513.	-0.00398	0.00	8.93E+09	-278.973	2268.	0.00
3.6800	0.2285	-215470.	20971.	-0.00403	0.00	8.93E+09	-285.711	2401.	0.00
3.8400	0.2207	-174626.	20416.	-0.00407	0.00	8.93E+09	-292.199	2542.	0.00
4.0000	0.2128	-134849.	19849.	-0.00411	0.00	8.93E+09	-298.428	2692.	0.00
4.1600	0.2049	-96165.	19270.	-0.00413	0.00	8.93E+09	-304.392	2852.	0.00
4.3200	0.1970	-58597.	18680.	-0.00415	0.00	8.93E+09	-310.083	3023.	0.00
4.4800	0.1890	-22169.	18080.	-0.00416	0.00	8.94E+09	-315.498	3205.	0.00
4.6400	0.1810	13098.	17469.	-0.00416	0.00	8.94E+09	-320.633	3401.	0.00
4.8000	0.1730	47182.	16849.	-0.00415	0.00	8.93E+09	-325.437	3611.	0.00
4.9600	0.1651	80063.	16220.	-0.00414	0.00	8.93E+09	-329.781	3836.	0.00
5.1200	0.1571	111724.	15583.	-0.00412	0.00	8.93E+09	-333.631	4077.	0.00
5.2800	0.1492	142148.	14939.	-0.00409	0.00	8.93E+09	-336.958	4335.	0.00
5.4400	0.1414	171322.	14289.	-0.00406	0.00	8.93E+09	-339.728	4612.	0.00
5.6000	0.1337	199234.	13635.	-0.00402	0.00	8.93E+09	-341.910	4911.	0.00
5.7600	0.1260	225873.	12977.	-0.00397	0.00	8.93E+09	-343.467	5234.	0.00
5.9200	0.1184	251233.	12317.	-0.00392	0.00	8.93E+09	-344.362	5583.	0.00
6.0800	0.1109	275309.	11655.	-0.00386	0.00	8.93E+09	-344.558	5963.	0.00
6.2400	0.1036	298099.	10994.	-0.00380	0.00	8.93E+09	-344.010	6376.	0.00
6.4000	0.09635	319603.	10335.	-0.00373	0.00	8.93E+09	-342.674	6828.	0.00
6.5600	0.08925	339825.	9679.	-0.00366	0.00	8.93E+09	-340.499	7325.	0.00
6.7200	0.08228	358771.	9029.	-0.00359	0.00	8.93E+09	-337.429	7873.	0.00
6.8800	0.07547	376453.	8385.	-0.00351	0.00	8.93E+09	-333.401	8482.	0.00
7.0400	0.06881	392884.	7749.	-0.00343	0.00	8.93E+09	-328.343	9162.	0.00
7.2000	0.06231	408081.	7125.	-0.00334	0.00	8.93E+09	-322.172	9928.	0.00
7.3600	0.05598	422067.	6521.	-0.00325	0.00	8.93E+09	-306.384	10509.	0.00
7.5200	0.04982	434898.	5962.	-0.00316	0.00	8.93E+09	-276.704	10664.	0.00
7.6800	0.04384	446684.	5459.	-0.00306	0.00	8.83E+09	-247.043	10819.	0.00
7.8400	0.03805	457533.	5013.	-0.00297	0.00	8.79E+09	-217.483	10973.	0.00
8.0000	0.03245	467553.	2685.	-0.00286	0.00	8.78E+09	-2207.	130596.	0.00
8.1600	0.02705	469407.	-2409.	-0.00276	0.00	8.78E+09	-3099.	219928.	0.00
8.3200	0.02185	459810.	-7903.	-0.00266	0.00	8.79E+09	-2624.	230632.	0.00
8.4800	0.01683	440512.	-12458.	-0.00256	0.00	8.89E+09	-2121.	241879.	0.00
8.6400	0.01200	413371.	-16017.	-0.00247	0.00	8.93E+09	-1586.	253707.	0.00
8.8000	0.00735	380357.	-18517.	-0.00239	0.00	8.93E+09	-1018.	266163.	0.00
8.9600	0.00284	343568.	-19892.	-0.00231	0.00	8.93E+09	-413.649	279310.	0.00
9.1200	-0.00152	305234.	-20154.	-0.00190	0.00	7.88E+08	140.2566	177545.	0.00
9.2800	-0.00445	267213.	-19633.	-0.00128	0.00	1.04E+09	402.3059	173617.	0.00
9.4400	-0.00643	230541.	-18697.	-8.59E-04	0.00	1.27E+09	573.2256	171083.	0.00
9.6000	-0.00775	195887.	-17490.	-5.54E-04	0.00	1.45E+09	683.7249	169469.	0.00
9.7600	-0.00856	163682.	-16112.	-3.24E-04	0.00	1.58E+09	751.2502	168505.	0.00

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9.9200	-0.00899	134192.	-14636.	-1.44E-04	0.00	1.59E+09	786.8930	168020.	0.00
10.0800	-0.00911	107559.	-13115.	2.42E-06	0.00	1.59E+09	796.9087	167916.	0.00
10.2400	-0.00898	83828.	-11595.	1.18E-04	0.00	1.59E+09	786.5099	168112.	0.00
10.4000	-0.00866	62969.	-10110.	2.06E-04	0.00	1.59E+09	760.1122	168540.	0.00
10.5600	-0.00819	44891.	-8688.	2.71E-04	0.00	1.59E+09	721.4930	169143.	0.00
10.7200	-0.00762	29458.	-7349.	3.16E-04	0.00	1.59E+09	673.9004	169872.	0.00
10.8800	-0.00698	16500.	-6106.	3.44E-04	0.00	1.60E+09	620.1276	170685.	0.00
11.0400	-0.00630	5822.	-4971.	3.57E-04	0.00	1.60E+09	562.5661	171546.	0.00
11.2000	-0.00560	-2783.	-3948.	3.59E-04	0.00	1.60E+09	503.2434	172427.	0.00
11.3600	-0.00492	-9533.	-3039.	3.52E-04	0.00	1.60E+09	443.8513	173302.	0.00
11.5200	-0.00425	-14643.	-2242.	3.37E-04	0.00	1.60E+09	385.7761	174153.	0.00
11.6800	-0.00362	-18327.	-1555.	3.17E-04	0.00	1.60E+09	330.1202	174963.	0.00
11.8400	-0.00303	-20787.	-971.288	2.94E-04	0.00	1.60E+09	277.7275	175721.	0.00
12.0000	-0.00249	-22217.	-484.630	2.68E-04	0.00	1.60E+09	229.2080	176420.	0.00
12.1600	-0.00201	-22794.	-87.025	2.41E-04	0.00	1.60E+09	184.9641	177053.	0.00
12.3200	-0.00157	-22682.	229.9501	2.13E-04	0.00	1.60E+09	145.2179	177620.	0.00
12.4800	-0.00119	-22028.	474.9955	1.87E-04	0.00	1.60E+09	110.0376	178118.	0.00
12.6400	-8.53E-04	-20960.	656.8216	1.61E-04	0.00	1.60E+09	79.3646	178551.	0.00
12.8000	-5.69E-04	-19593.	783.9283	1.36E-04	0.00	1.60E+09	53.0383	178920.	0.00
12.9600	-3.30E-04	-18024.	864.4328	1.14E-04	0.00	1.60E+09	30.8205	179230.	0.00
13.1200	-1.33E-04	-16336.	905.9404	9.30E-05	0.00	1.60E+09	12.4165	179486.	0.00
13.2800	2.68E-05	-14596.	915.4558	7.43E-05	0.00	1.60E+09	-2.505	179623.	0.00
13.4400	1.53E-04	-12861.	899.3549	5.78E-05	0.00	1.60E+09	-14.267	179462.	0.00
13.6000	2.49E-04	-11174.	863.3490	4.34E-05	0.00	1.60E+09	-23.239	179339.	0.00
13.7600	3.19E-04	-9569.	812.4372	3.09E-05	0.00	1.60E+09	-29.794	179251.	0.00
13.9200	3.67E-04	-8071.	750.9206	2.03E-05	0.00	1.60E+09	-34.286	179191.	0.00
14.0800	3.97E-04	-6697.	682.4483	1.14E-05	0.00	1.60E+09	-37.040	179155.	0.00
14.2400	4.11E-04	-5457.	610.0707	4.07E-06	0.00	1.60E+09	-38.354	179139.	0.00
14.4000	4.13E-04	-4356.	536.2954	-1.83E-06	0.00	1.60E+09	-38.495	179139.	0.00
14.5600	4.04E-04	-3396.	463.1463	-6.49E-06	0.00	1.60E+09	-37.701	179151.	0.00
14.7200	3.88E-04	-2574.	392.2223	-1.01E-05	0.00	1.60E+09	-36.178	179173.	0.00
14.8800	3.65E-04	-1885.	324.7549	-1.28E-05	0.00	1.60E+09	-34.101	179202.	0.00
15.0400	3.39E-04	-1320.	261.6645	-1.47E-05	0.00	1.60E+09	-31.618	179236.	0.00
15.2000	3.09E-04	-872.016	203.6137	-1.60E-05	0.00	1.60E+09	-28.851	179274.	0.00
15.3600	2.77E-04	-529.748	151.0568	-1.68E-05	0.00	1.60E+09	-25.896	179314.	0.00
15.5200	2.44E-04	-282.768	104.2856	-1.73E-05	0.00	1.60E+09	-22.825	179356.	0.00
15.6800	2.11E-04	-119.835	63.4704	-1.76E-05	0.00	1.60E+09	-19.691	179398.	0.00
15.8400	1.77E-04	-29.453	28.6973	-1.77E-05	0.00	1.60E+09	-16.531	179440.	0.00
16.0000	1.43E-04	0.00	0.00	-1.77E-05	0.00	1.60E+09	-13.362	89741.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.34145447 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -1378836. inch-lbs
 Maximum shear force = 29590. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 16
 Number of zero deflection points = 2

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

Shear = 29590. lbs
 Slope = 0.00000

Proposal No. 608929 - 123406

Axial Load = 142140. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
16.00000	0.34145447	-1378836.	29590.
15.20000	0.34137663	-1378765.	29590.
14.40000	0.34463604	-1382944.	29590.
13.60000	0.34006340	-1377803.	29590.
12.80000	0.34430632	-1382274.	29590.
12.00000	0.34100050	-1378562.	29590.
11.20000	0.34594587	-1383237.	29590.
10.40000	0.35844810	-1399303.	29590.
9.60000	0.41993882	-1489328.	29590.
8.80000	0.47198280	-1598605.	29590.
8.00000	0.48749072	-1649837.	29590.
7.20000	0.51441582	-1585145.	29590.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 142140.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-3052471.	52431.	0.00	0.00	7.25E+09	-112.920	108.4033	0.00
0.1600	0.9992	-2951921.	52196.	-7.95E-04	0.00	7.25E+09	-121.405	233.2778	0.00
0.3200	0.9969	-2851605.	51954.	-0.00154	0.00	7.74E+09	-130.400	251.1344	0.00
0.4800	0.9933	-2751577.	51695.	-0.00223	0.00	7.83E+09	-139.669	269.9704	0.00
0.6400	0.9884	-2651880.	51417.	-0.00289	0.00	7.88E+09	-149.208	289.8475	0.00
0.8000	0.9822	-2552556.	51122.	-0.00352	0.00	7.91E+09	-159.013	310.8346	0.00
0.9600	0.9748	-2453649.	50807.	-0.00413	0.00	7.92E+09	-169.079	333.0075	0.00
1.1200	0.9663	-2355204.	50471.	-0.00471	0.00	7.94E+09	-180.046	357.7272	0.00
1.2800	0.9567	-2257266.	50115.	-0.00527	0.00	7.95E+09	-191.440	384.1815	0.00
1.4400	0.9461	-2159886.	49736.	-0.00580	0.00	7.97E+09	-203.180	412.3274	0.00
1.6000	0.9345	-2063113.	49334.	-0.00631	0.00	7.99E+09	-215.265	442.2951	0.00
1.7600	0.9219	-1966997.	48909.	-0.00680	0.00	8.01E+09	-227.696	474.2266	0.00
1.9200	0.9084	-1871593.	48460.	-0.00725	0.00	8.03E+09	-240.472	508.2783	0.00
2.0800	0.8940	-1776953.	47985.	-0.00769	0.00	8.05E+09	-253.593	544.6216	0.00
2.2400	0.8788	-1683132.	47485.	-0.00810	0.00	8.07E+09	-267.059	583.4451	0.00
2.4000	0.8629	-1590186.	46959.	-0.00849	0.00	8.09E+09	-280.871	624.9571	0.00
2.5600	0.8462	-1498172.	46407.	-0.00886	0.00	8.12E+09	-295.029	669.3872	0.00
2.7200	0.8289	-1407150.	45826.	-0.00920	0.00	8.15E+09	-309.531	716.9899	0.00
2.8800	0.8109	-1317178.	45218.	-0.00952	0.00	8.18E+09	-324.380	768.0476	0.00
3.0400	0.7923	-1228317.	44580.	-0.00982	0.00	8.21E+09	-339.573	822.8739	0.00
3.2000	0.7732	-1140630.	43913.	-0.01010	0.00	8.25E+09	-355.112	881.8187	0.00
3.3600	0.7536	-1054179.	43216.	-0.01035	0.00	8.29E+09	-370.996	945.2729	0.00
3.5200	0.7334	-969030.	42488.	-0.01058	0.00	8.33E+09	-387.226	1014.	0.00
3.6800	0.7129	-885246.	41729.	-0.01080	0.00	8.38E+09	-403.801	1088.	0.00
3.8400	0.6920	-802896.	40937.	-0.01099	0.00	8.44E+09	-420.721	1167.	0.00
4.0000	0.6707	-722048.	40113.	-0.01116	0.00	8.50E+09	-437.987	1254.	0.00
4.1600	0.6491	-642769.	39255.	-0.01132	0.00	8.58E+09	-455.598	1348.	0.00
4.3200	0.6272	-565130.	38363.	-0.01145	0.00	8.66E+09	-473.554	1450.	0.00
4.4800	0.6051	-489203.	37436.	-0.01157	0.00	8.75E+09	-491.856	1561.	0.00
4.6400	0.5828	-415060.	36474.	-0.01167	0.00	8.93E+09	-510.504	1682.	0.00
4.8000	0.5603	-342775.	35476.	-0.01175	0.00	8.93E+09	-529.496	1814.	0.00
4.9600	0.5377	-272421.	34441.	-0.01181	0.00	8.93E+09	-548.834	1960.	0.00
5.1200	0.5150	-204075.	33368.	-0.01186	0.00	8.93E+09	-568.518	2120.	0.00
5.2800	0.4922	-137812.	32257.	-0.01190	0.00	8.93E+09	-588.546	2296.	0.00

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5.4400	0.4693	-73711.	31108.	-0.01192	0.00	8.93E+09	-608.920	2491.	0.00
5.6000	0.4464	-11851.	29919.	-0.01193	0.00	8.94E+09	-629.640	2708.	0.00
5.7600	0.4235	47690.	28689.	-0.01193	0.00	8.93E+09	-650.704	2950.	0.00
5.9200	0.4006	104828.	27422.	-0.01191	0.00	8.93E+09	-669.221	3208.	0.00
6.0800	0.3777	159494.	26142.	-0.01188	0.00	8.93E+09	-664.333	3377.	0.00
6.2400	0.3549	211701.	24873.	-0.01184	0.00	8.93E+09	-658.177	3561.	0.00
6.4000	0.3322	261470.	23616.	-0.01179	0.00	8.93E+09	-650.747	3761.	0.00
6.5600	0.3096	308824.	22375.	-0.01173	0.00	8.93E+09	-642.039	3981.	0.00
6.7200	0.2872	353793.	21152.	-0.01166	0.00	8.93E+09	-632.052	4226.	0.00
6.8800	0.2648	396412.	19949.	-0.01158	0.00	8.93E+09	-620.788	4500.	0.00
7.0400	0.2427	436719.	18769.	-0.01149	0.00	8.92E+09	-608.248	4812.	0.00
7.2000	0.2207	474757.	17615.	-0.01139	0.00	8.77E+09	-594.440	5171.	0.00
7.3600	0.1989	510577.	16488.	-0.01128	0.00	8.73E+09	-579.374	5591.	0.00
7.5200	0.1774	544229.	15391.	-0.01117	0.00	8.68E+09	-563.054	6094.	0.00
7.6800	0.1561	575774.	14328.	-0.01104	0.00	8.65E+09	-544.223	6695.	0.00
7.8400	0.1350	605277.	13305.	-0.01091	0.00	8.62E+09	-521.544	7418.	0.00
8.0000	0.1142	632821.	8856.	-0.01077	0.00	8.59E+09	-4112.	69164.	0.00
8.1600	0.09361	645166.	-1593.	-0.01063	0.00	8.58E+09	-6773.	138911.	0.00
8.3200	0.07334	632505.	-13844.	-0.01049	0.00	8.59E+09	-5988.	156768.	0.00
8.4800	0.05333	597731.	-24374.	-0.01035	0.00	8.62E+09	-4981.	179323.	0.00
8.6400	0.03359	544558.	-32662.	-0.01022	0.00	8.68E+09	-3651.	208727.	0.00
8.8000	0.01407	477891.	-37917.	-0.01011	0.00	8.77E+09	-1823.	248700.	0.00
8.9600	-0.00524	404476.	-38953.	-0.01002	0.00	8.93E+09	743.1309	272221.	0.00
9.1200	-0.02439	333777.	-36401.	-0.00513	0.00	6.61E+07	1915.	150788.	0.00
9.2800	-0.02493	267493.	-32689.	-2.98E-05	0.00	1.03E+09	1952.	150345.	0.00
9.4400	-0.02450	208268.	-28967.	3.65E-04	0.00	1.39E+09	1925.	150856.	0.00
9.6000	-0.02353	156062.	-25331.	6.03E-04	0.00	1.58E+09	1861.	151916.	0.00
9.7600	-0.02219	110666.	-21843.	7.65E-04	0.00	1.59E+09	1772.	153350.	0.00
9.9200	-0.02059	71766.	-18546.	8.75E-04	0.00	1.59E+09	1663.	155064.	0.00
10.0800	-0.01883	38972.	-15472.	9.42E-04	0.00	1.59E+09	1539.	156978.	0.00
10.2400	-0.01697	11839.	-12645.	9.72E-04	0.00	1.60E+09	1406.	159021.	0.00
10.4000	-0.01509	-10115.	-10080.	9.73E-04	0.00	1.60E+09	1267.	161132.	0.00
10.5600	-0.01323	-27398.	-7784.	9.51E-04	0.00	1.59E+09	1125.	163257.	0.00
10.7200	-0.01144	-40523.	-5757.	9.10E-04	0.00	1.59E+09	985.2007	165350.	0.00
10.8800	-0.00974	-50003.	-3997.	8.55E-04	0.00	1.59E+09	849.0180	167371.	0.00
11.0400	-0.00815	-56337.	-2491.	7.91E-04	0.00	1.59E+09	719.0177	169289.	0.00
11.2000	-0.00670	-60002.	-1228.	7.21E-04	0.00	1.59E+09	597.0239	171078.	0.00
11.3600	-0.00538	-61446.	-189.739	6.48E-04	0.00	1.59E+09	484.4066	172720.	0.00
11.5200	-0.00421	-61084.	642.1094	5.74E-04	0.00	1.59E+09	382.1021	174204.	0.00
11.6800	-0.00318	-59294.	1288.	5.02E-04	0.00	1.59E+09	290.6442	175523.	0.00
11.8400	-0.00228	-56412.	1769.	4.32E-04	0.00	1.59E+09	210.2065	176677.	0.00
12.0000	-0.00152	-52738.	2106.	3.66E-04	0.00	1.59E+09	140.6520	177670.	0.00
12.1600	-8.78E-04	-48527.	2319.	3.05E-04	0.00	1.59E+09	81.5876	178508.	0.00
12.3200	-3.47E-04	-43999.	2428.	2.50E-04	0.00	1.59E+09	32.4191	179202.	0.00
12.4800	8.11E-05	-39338.	2452.	1.99E-04	0.00	1.59E+09	-7.585	179552.	0.00
12.6400	4.19E-04	-34692.	2407.	1.55E-04	0.00	1.59E+09	-39.052	179113.	0.00
12.8000	6.76E-04	-30178.	2310.	1.16E-04	0.00	1.59E+09	-62.940	178783.	0.00
12.9600	8.63E-04	-25886.	2172.	8.21E-05	0.00	1.59E+09	-80.297	178545.	0.00
13.1200	9.91E-04	-21882.	2007.	5.34E-05	0.00	1.60E+09	-92.091	178386.	0.00
13.2800	0.00107	-18210.	1823.	2.92E-05	0.00	1.60E+09	-99.207	178292.	0.00
13.4400	0.00110	-14898.	1629.	9.30E-06	0.00	1.60E+09	-102.440	178252.	0.00
13.6000	0.00110	-11959.	1433.	-6.86E-06	0.00	1.60E+09	-102.502	178255.	0.00
13.7600	0.00108	-9393.	1238.	-1.97E-05	0.00	1.60E+09	-100.018	178293.	0.00
13.9200	0.00103	-7194.	1050.	-2.97E-05	0.00	1.60E+09	-95.532	178358.	0.00
14.0800	9.63E-04	-5344.	872.7821	-3.72E-05	0.00	1.60E+09	-89.509	178444.	0.00
14.2400	8.85E-04	-3822.	707.8082	-4.27E-05	0.00	1.60E+09	-82.339	178544.	0.00
14.4000	7.99E-04	-2602.	557.3914	-4.66E-05	0.00	1.60E+09	-74.345	178655.	0.00
14.5600	7.07E-04	-1656.	422.8672	-4.92E-05	0.00	1.60E+09	-65.784	178773.	0.00
14.7200	6.10E-04	-951.722	305.1305	-5.07E-05	0.00	1.60E+09	-56.858	178895.	0.00
14.8800	5.12E-04	-456.674	204.7402	-5.16E-05	0.00	1.60E+09	-47.715	179020.	0.00
15.0400	4.12E-04	-137.374	122.0103	-5.19E-05	0.00	1.60E+09	-38.462	179145.	0.00
15.2000	3.12E-04	40.1855	57.0881	-5.20E-05	0.00	1.60E+09	-29.166	179270.	0.00
15.3600	2.13E-04	110.2161	10.0187	-5.19E-05	0.00	1.60E+09	-19.865	179394.	0.00
15.5200	1.13E-04	106.9799	-19.204	-5.18E-05	0.00	1.60E+09	-10.575	179518.	0.00
15.6800	1.39E-05	64.7237	-30.601	-5.17E-05	0.00	1.60E+09	-1.296	179640.	0.00
15.8400	-8.53E-05	17.6691	-24.191	-5.16E-05	0.00	1.60E+09	7.9729	179553.	0.00
16.0000	-1.84E-04	0.00	0.00	-5.16E-05	0.00	1.60E+09	17.2257	89716.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-

tionships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

* WARNING: Some values of computed curvature exceeded the maximum curvature calculated or entered by the user
 Depth = 9.1200 ft Computed Curv. = 0.00505 rad/in Maximum Curv. = 7.89E-04 rad/in

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -3052471. inch-lbs
 Maximum shear force = 52431. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 22
 Number of zero deflection points = 3

 Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	39560.	S, rad	0.00	186610.	0.5536	0.00	39560.	-2008742.
2	V, lb	29590.	S, rad	0.00	142140.	0.3415	0.00	29590.	-1378836.
3	y, in	1.0000	S, rad	0.00	142140.	1.0000	0.00	52431.	-3052471.





Maximum pile-head deflection = 1.000000000 inches
 Maximum pile-head rotation = 0.000000000 radians = 0.000000 deg.

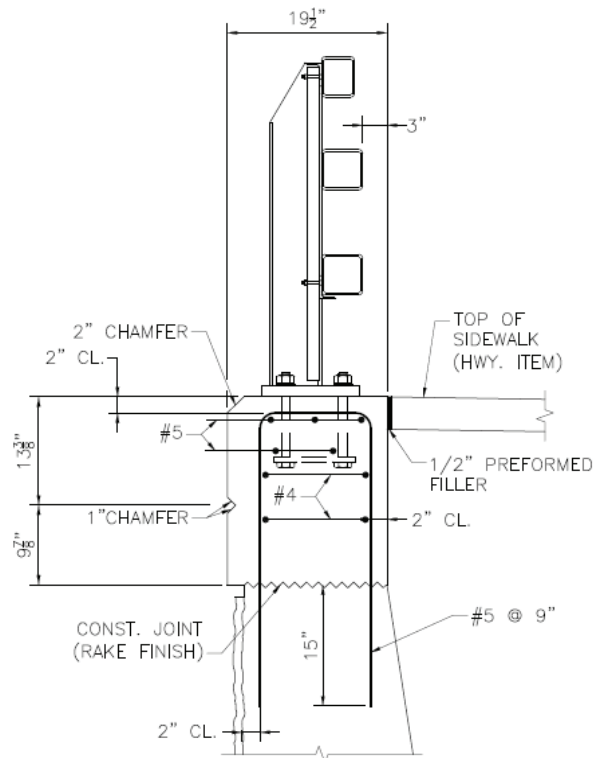
The analysis ended normally.

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023	
Detail: Unfactored Vertical Load	Checked by: JG	Date: 5/2023	

Wingwall Type 1

Unfactored Vertical Load

	W (ft)	H (ft)	unit weight		
Coping	(1.63)	(1.94)	(0.15 kcf)	=	0.47 k/ft
Stem 	(1.54)	(26.18)	(0.15 kcf)	=	6.05 k/ft
Stem 	0.5 (2.18)	(26.18)	(0.15 kcf)	=	4.28 k/ft
Concrete Footing	(12.00)	(3.50)	(0.15 kcf)	=	6.30 k/ft
Vertical Soil 1 	0.5 (2.18)	(28.12)	(0.12 kcf)	=	3.68 k/ft
Vertical Soil 2 	(4.90)	(28.12)	(0.12 kcf)	=	16.54 k/ft
Bridge Railing S3-TL4 at Sidewalk				=	0.090 k/ft



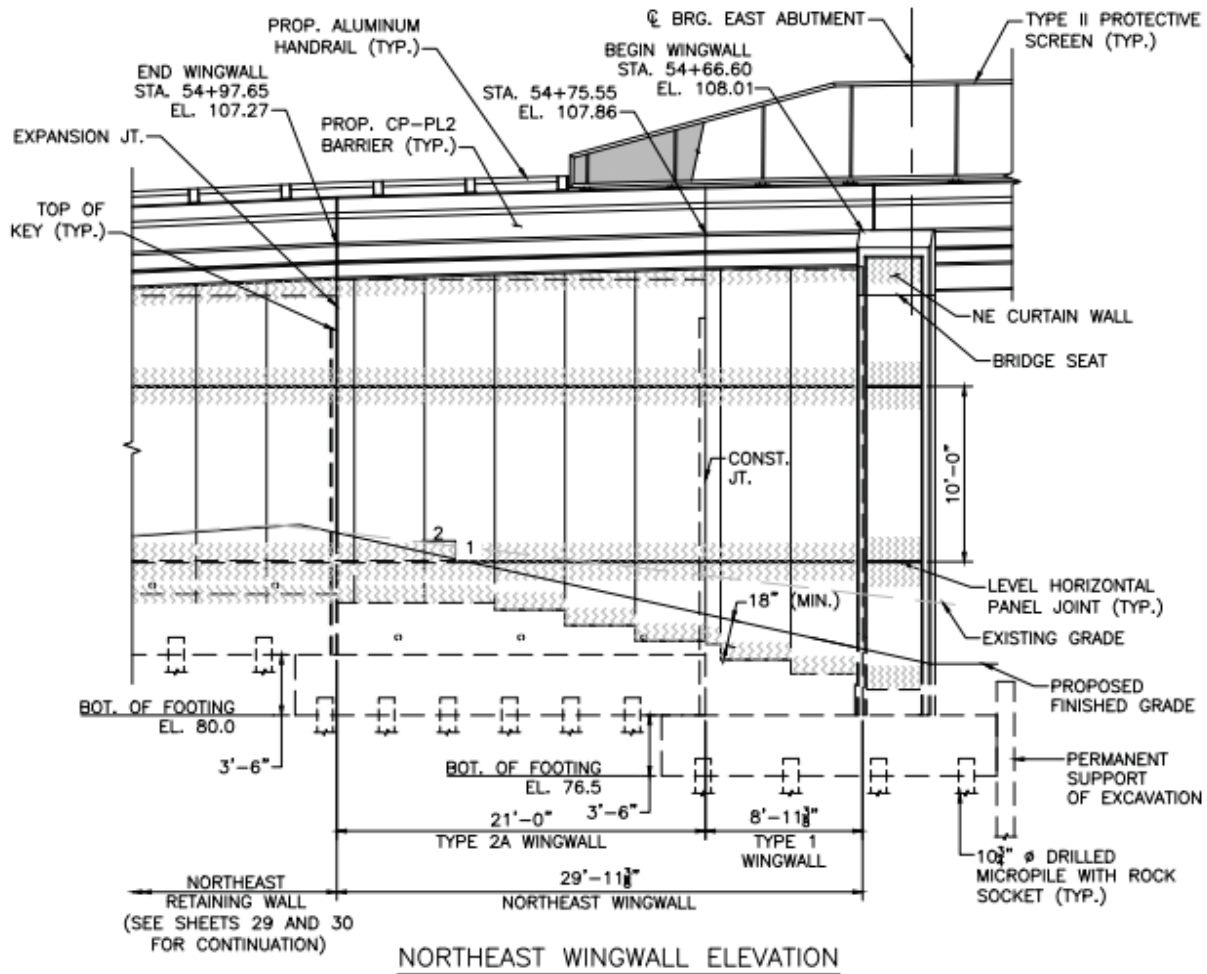
TOP OF U-WINGWALL/RETAINING WALL
DETAILS AT SIDEWALK

LAMSON ENGINEERING CORPORATION				Final Page No.:	
Project:	Bridge No. W-38-003	Job No.:		Preliminary Sheet No.:	
Subject:	Wingwall - 10.75 Micropile	Prepared by:	SL	Date:	5/2023
Detail:	Unfactored Vertical Load	Checked by:	JG	Date:	5/2023

Wingwall Type 1

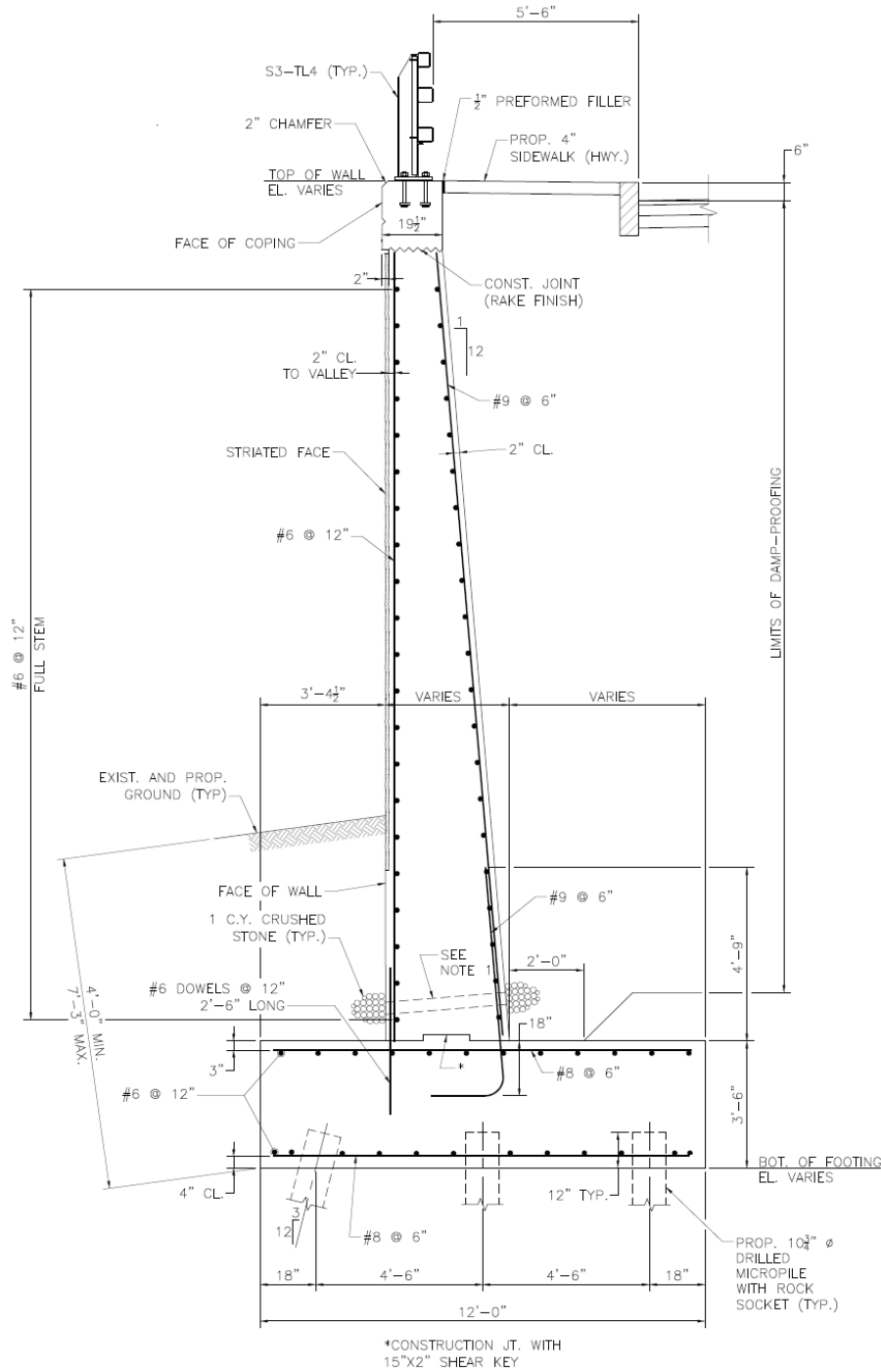
STA.	Elevation	STA.	Elevation	Length (ft.)	Bottom of Footing Elevation	Design H at highest 1/4 point (ft)	
54+02.43	107.07	54+11.38	107.42	8.9	77	30.68	SW Wingwall
54+57.49	108.06	54+67.44	107.95	9.9	76.5	31.53	SE Wingwall
54+10.54	107.34	54+20.49	107.67	9.9	77	30.92	NW Wingwall
54+75.55	107.86	54+66.60	108.01	8.9	76.5	31.62	NE Wingwall

By Investigations above, NE wingwall controls for micropile design.



LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023	
Detail: Unfactored Vertical Load	Checked by: JG	Date: 5/2023	

Wingwall Type 1



RETAINING WALL TYPE 1 TYPICAL SECTION

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023
Detail: Lateral earth pressure	Checked by: JG	Date: 5/2023

Determine Unfactored Horizontal Load

Effective angle of internal friction ϕ'_f	=	37	degree
Friction angle between fill and wall, δ	=	0	degree
Angle of fill to the horizontal, β	=	0.00	degree
Angle of back of wall to the horizontal, θ	=	90	degree
Unit weight of soil, γ_{soil}	=	0.125	kcf
Total unit weight of water, γ_w	=	0.0624	kcf
Height of Soil	=	31.62	ft ±
Distance from back of wall to footing heel, B_{heel}	=	7.08	ft
Height of fill behind footing at heel, $h = H + B_{\text{heel}} \tan \beta$	=	31.62	ft ±
Height of water from bottom of footing, H_w	=	0	ft

Lateral Earth Pressure (EH)

$$\text{Active pressure coefficient, } K_a = \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta) \left[1 + \sqrt{\frac{\sin(\phi'_f + \delta) \sin(\phi'_f - \beta)}{\sin(\theta - \delta) \sin(\theta + \beta)}} \right]^2}$$

$$= 0.249$$

$$\text{At-rest pressure coefficient, } K_o = 1 - \sin \phi'_f = 1 - \sin(37)$$

$$= 0.398$$

Per *massDOT* LRFD BM 3.1.5

Founded on Pile = Y (Input Y if yes)

$$K_e = K_o = 0.398$$

$$\text{Lateral earth pressure, } P_{e1} = 0.5 K_e \gamma_{\text{soil}} (h - H_w)^2$$

$$= 0.5 \times 0.398 \times 0.125 \text{ kcf} \times (31.62 \text{ ft} - 0 \text{ ft})^2$$

$$= 24.88 \text{ k/ft length of wall}$$

$$\text{Vertical component of } P_{e1}, P_{ev1} = P_{e1} \sin(90 - \theta + \delta)$$

$$= 24.88 \text{ k/ft} \times \sin(90 - 90 + 0)$$

$$= 0.00 \text{ k/ft}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023
Detail: Lateral earth pressure	Checked by: JG	Date: 5/2023

$$\begin{aligned}
 \text{Horizontal component of } P_{e1}, P_{eh1} &= P_{e1} \cos (90 - \theta + \delta) \\
 &= 24.88 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 24.88 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Lateral earth pressure, } P_{e2} &= K_e \gamma_{\text{soil}} (h - H_w) H_w \\
 &= 0.398 \times 0.125 \text{ kcf} \times (31.62 \text{ ft} - 0 \text{ ft}) \times 0 \text{ ft} \\
 &= 0.00 \text{ k/ft length of wall}
 \end{aligned}$$

$$\begin{aligned}
 \text{Vertical component of } P_{e2}, P_{ev2} &= P_{e2} \sin (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Horizontal component of } P_{e2}, P_{eh2} &= P_{e2} \cos (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Lateral earth pressure, } P_{e3} &= 0.5 K_e \gamma' (H_w)^2 \\
 &= 0.5 \times 0.398 \times (0.125 \text{ kcf} - 0.0624 \text{ kcf}) \times 0 \text{ ft}^2 \\
 &= 0.00 \text{ k/ft length of wall}
 \end{aligned}$$

$$\begin{aligned}
 \text{Vertical component of } P_{e3}, P_{ev3} &= P_{e3} \sin (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Horizontal component of } P_{e3}, P_{eh3} &= P_{e3} \cos (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

Live Load Surcharge (LS) (AASHTO LRFD 3.11.6.4)

$$\text{Equivalent height of soil for, } h_{eq} = 2.000 \text{ ft}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023
Detail: Lateral earth pressure	Checked by: JG	Date: 5/2023

$$\begin{aligned} \text{Vertical live load Surcharge on heel, LS} &= 0.125 \text{ kcf} \times 2 \text{ ft} \times 7.083 \text{ ft} \\ &= 1.771 \text{ k / ft} \end{aligned}$$

$$\begin{aligned} \text{Horizontal earth pressure due to live load surcharge } \Delta_p &= K_e \gamma_{\text{soil}} h_{eq} \\ &= 0.398 \times 0.125 \text{ kcf} \times 2 \text{ ft} \\ &= 0.10 \text{ ksf} \end{aligned}$$

$$\begin{aligned} \text{Live load lateral earth pressure, } P_{LS} &= \Delta_p h \\ &= 0.1 \text{ ksf} \times 31.62 \text{ ft} \\ &= 3.15 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Vertical component of } P_{LS}, P_{LSV} &= P_{LS} \sin (90 - \alpha + \delta) \\ &= 3.15 \text{ k/ft} \times \sin (90 - 90 + 0) \\ &= 0.00 \text{ k/ft length of wall} \end{aligned}$$





$$\begin{aligned} \text{Horizontal component of } P_{LS}, P_{LSH} &= P_{LS} \cos (90 - \alpha + \delta) \\ &= 3.15 \text{ k/ft} \times \cos (90 - 90 + 0) \\ &= 3.15 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Unfactored horizontal load, EH + LSH} &= P_{eh1} + P_{eh2} + P_{eh3} + P_{LSH} \\ &= 24.88 + 0 + 0 + 3.15 \\ &= \underline{28.03 \text{ k/ft length of wall}} \end{aligned}$$

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project:	Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject:	Wingwall - 10.75 Micropile	Prepared by: SL		Date: 5/2023
Detail:	Strength I for Overturning	Checked by: JG		Date: 5/2023

Summary of Factored Loads - Strength IA: 1.25DC + 1.35EH + 1.35EV + 1.75 LS

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (k/ft)	Factored vertical load, V_u (k/ft)	Arm about CL Footing	Factored Moment	
Coping	1.25	0.47	0.59	1.90	1.12	
Stem 	1.25	6.05	7.57	1.85	14.03	
Stem 	1.25	4.28	5.35	0.36	1.91	
Concrete Footing	1.25	6.30	7.88	0.00	0.00	
Vertical Soil 1 	1.35	3.68	4.97	-0.37	-1.84	
Vertical Soil 2 	1.35	16.54	22.33	-3.55	-79.25	
Bridge Railing	1.25	0.09	0.11	1.90	0.21	
P_{v1}	1.35	0.00	0.00	-6.00	0.00	
P_{v2}	1.35	0.00	0.00	-6.00	0.00	
P_{v3}	1.35	0.00	0.00	-6.00	0.00	
P_{LSV}	1.75	0.00	0.00	-6.00	0.00	
LS	1.75	1.77	3.10	-3.55	-11.00	
TOTAL		39.19	51.90		-74.82	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (k/ft)	Factored horizontal load, H_u (k/ft)	Arm about CL Footing	Factored Moment	
P_{h1}	1.35	24.88	33.59	10.54	354.05	
P_{h2}	1.35	0.00	0.00	0.00	0.00	
P_{h3}	1.35	0.00	0.00	0.00	0.00	
P_{LSH}	1.75	3.15	5.51	15.81	87.09	
TOTAL		28.03	39.10		441.14	ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date:	12/2022
Detail: Pile_STR I_VMAX	Checked by: JG/FL	Date:	12/2022

Pile STR I VMAX

Cross Section = 0.63 ft.²

Number of Pile, n = 9

Length to Wall 8.9 ft

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Horizontal Resistance (Front Piles battered 1:4) = 208.13 x 3 ea / 4 = 156.1 kips

Vertical, F_z = 461.89 kips

F_y = 347.98 - 156.1 = 191.88 kips

F_x = 0.00 kips

M_x = (-74.82+441.14) k-ft/ft x 8.9 ft + 461.89 k x 0 ft
= 3260.20 k-ft

M_y = 0.00 kips-ft

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	$\frac{M_x(Y_{C.G.} - Y_i)}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_{C.G.} - X_i)}{\sum (X_i - X_{C.G.})^2}$	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	0.00	-4.50	0.000	-2.836	12.250	20.250	120.75	0.00	51.321	172.07	21.32	0.00
2	0.63	3.50	-4.50	2.206	-2.836	0.000	20.250	120.75	0.00	51.321	172.07	21.32	0.00
3	0.63	7.00	-4.50	4.412	-2.836	12.250	20.250	120.75	0.00	51.321	172.07	21.32	0.00
1	0.63	0.00	0.00	0.000	0.000	12.250	0.000	0.00	0.00	51.321	51.32	21.32	0.00
2	0.63	3.50	0.00	2.206	0.000	0.000	0.000	0.00	0.00	51.321	51.32	21.32	0.00
3	0.63	7.00	0.00	4.412	0.000	12.250	0.000	0.00	0.00	51.321	51.32	21.32	0.00
1	0.63	0.00	4.50	0.000	2.836	12.250	20.250	-120.75	0.00	51.321	-69.43	21.32	0.00
2	0.63	3.50	4.50	2.21	2.84	0.00	20.25	-120.75	0.00	51.32	-69.43	21.32	0.00
3	0.63	7.00	4.50	4.412	2.836	12.250	20.250	-120.75	0.00	51.321	-69.43	21.32	0.00
9	5.67			19.85	0.00						172.07 -69.43	21.32 21.32	

X_{C.G.} = ΣA_p X_i / ΣA_p = 19.85 / 5.67 = 3.500 ft. Y_{C.G.} = ΣA_p Y_i / ΣA_p = 0.00 / 5.67 = 0.000 ft. from Pile Cap Center

Σ(X_i - X_{C.G.})² = 74 ft.² Σ(Y_i - Y_{C.G.})² = 121.50 ft.²

Resultant Shear on Single Pile = (21.32² + 0.00²)^{0.5} = 21.32 kips

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project:	Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject:	Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023	
Detail:	Strength I for Sliding and Eccentricity	Checked by: JG	Date: 5/2023	

Summary of Factored Loads - Strength IB: 0.90DC + 1.35EH + 1.0EV + 1.75 LS

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (k/ft)	Factored vertical load, V_u (k/ft)	Arm about CL Footing	Factored Moment	
Coping	0.90	0.47	0.43	1.90	0.81	
Stem	0.90	6.05	5.45	1.85	10.10	
Stem	0.90	4.28	3.86	0.36	1.37	
Concrete Footing	0.90	6.30	5.67	0.00	0.00	
Vertical Soil 1	1.00	3.68	3.68	-0.37	-1.37	
Vertical Soil 2	1.00	16.54	16.54	-3.55	-58.70	
Bridge Railing	0.90	0.09	0.08	1.90	0.15	
P_{v1}	1.35	0.00	0.00	-6.00	0.00	
P_{v2}	1.35	0.00	0.00	-6.00	0.00	
P_{v3}	1.35	0.00	0.00	-6.00	0.00	
P_{LSV}	1.75	0.00	0.00	-6.00	0.00	
LS	1.75	0.00	0.00	-3.55	0.00	
TOTAL		37.42	35.70		-47.63	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (k/ft)	Factored horizontal load, H_u (k/ft)	Arm about CL Footing	Factored Moment	
P_{h1}	1.35	24.88	33.59	10.54	354.05	
P_{h2}	1.35	0.00	0.00	0.00	0.00	
P_{h3}	1.35	0.00	0.00	0.00	0.00	
P_{LSH}	1.75	3.15	5.51	15.81	87.09	
TOTAL		28.03	39.10		441.14	ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date:	12/2022
Detail: Pile_STR I_VMIN	Checked by: JG/FL	Date:	12/2022

Pile STR I_VMIN

Cross Section = 0.63 ft.²

Number of Pile, n = 9

Length between Expansion Joints = 8.9 ft

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Horizontal Resistance (Front Piles battered 1:4) = 208.13 x 3 ea / 4 = 156.1 kips

Vertical, F_z = 317.74 kips

F_y = 347.98 - 156.1 = 191.88 kips

F_x = 0.00 kips

M_x = (-47.63+441.14) k-ft/ft x 8.9 ft + 317.74 k x 0 ft
= 3502.16 k-ft

M_y = 0.00 kips-ft

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	$\frac{M_x(Y_{C.G.} - Y_i)}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_{C.G.} - X_i)}{\sum (X_i - X_{C.G.})^2}$	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	0.00	-4.50	0.000	-2.836	12.250	20.250	129.71	0.00	35.304	165.01	21.32	0.00
2	0.63	3.50	-4.50	2.206	-2.836	0.000	20.250	129.71	0.00	35.304	165.01	21.32	0.00
3	0.63	7.00	-4.50	4.412	-2.836	12.250	20.250	129.71	0.00	35.304	165.01	21.32	0.00
1	0.63	0.00	0.00	0.000	0.000	12.250	0.000	0.00	0.00	35.304	35.30	21.32	0.00
2	0.63	3.50	0.00	2.206	0.000	0.000	0.000	0.00	0.00	35.304	35.30	21.32	0.00
3	0.63	7.00	0.00	4.412	0.000	12.250	0.000	0.00	0.00	35.304	35.30	21.32	0.00
1	0.63	0.00	4.50	0.000	2.836	12.250	20.250	-129.71	0.00	35.304	-94.41	21.32	0.00
2	0.63	3.50	4.50	2.206	2.836	0.000	20.250	-129.71	0.00	35.304	-94.41	21.32	0.00
3	0.63	7.00	4.50	4.41	2.84	12.25	20.25	-129.71	0.00	35.30	-94.41	21.32	0.00
9	5.67			19.85	0.00						165.01 -94.41	21.32 21.32	

$$X_{C.G.} = \sum A_p X_i / \sum A_p = 19.85 / 5.67 = 3.500 \text{ ft.}$$

$$Y_{C.G.} = \sum A_p Y_i / \sum A_p = 0.00 / 5.67 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 74 \text{ ft.}^2 \quad \sum (Y_i - Y_{C.G.})^2 = 121.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (21.32^2 + 0.00^2)^{0.5} = 21.32 \text{ kips}$$

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project: Bridge No. W-38-003	Job No.:		Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL		Date: 5/2023	
Detail: Service I for Settlement	Checked by: JG		Date: 5/2023	

Summary of Factored Loads - Service I: 1.0DC + 1.0EH + 1.0EV

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (k/ft)	Factored vertical load, V_u (k/ft)	Arm about CL Footing	Factored Moment
Coping	1.00	0.47	0.47	1.90	0.90
Stem	1.00	6.05	6.05	1.85	11.23
Stem	1.00	4.28	4.28	0.36	1.53
Concrete Footing	1.00	6.30	6.30	0.00	0.00
Vertical Soil 1	1.00	3.68	3.68	-0.37	-1.37
Vertical Soil 2	1.00	16.54	16.54	-3.55	-58.70
Bridge Railing	1.00	0.09	0.09	1.90	0.17
P_{v1}	1.00	0.00	0.00	-6.00	0.00
P_{v2}	1.00	0.00	0.00	-6.00	0.00
P_{v3}	1.00	0.00	0.00	-6.00	0.00
P_{LSV}	1.00	0.00	0.00	-6.00	0.00
LS	1.00	1.77	1.77	-3.55	-6.28
TOTAL		39.19	39.19		-52.54

ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (k/ft)	Factored horizontal load, H_u (k/ft)	Arm about CL Footing	Factored Moment
P_{h1}	1.00	24.88	24.88	10.54	262.26
P_{h2}	1.00	0.00	0.00	0.00	0.00
P_{h3}	1.00	0.00	0.00	0.00	0.00
P_{LSH}	1.00	3.15	3.15	15.81	49.76
TOTAL		28.03	28.03		312.02

ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date:	12/2022
Detail: Pile_SERVICE I	Checked by: JG/FL	Date:	12/2022

Pile SERVICE I

Cross Section = 0.63 ft.²

Number of Pile, n = 9

Length to Expansion Joint = 8.9 ft

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Horizontal Resistance (Front Piles battered 1:4) = 208.13 x 3 ea / 4 = 156.1 kips

Vertical, F_z = 348.81 kips

F_y = 249.47 - 156.1 = 93.37 kips

F_x = 0.00 kips

M_x = (-52.54 + 312.02) k-ft/ft x 8.9 ft + 348.81 k x 0 ft
= 2309.41 k-ft

M_y = 0.00 kips-ft

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	M _x (Y _{C.G.} - Y _i) Σ (Y _i - Y _{C.G.}) ²	M _y (X _{C.G.} - X _i) Σ (X _i - X _{C.G.}) ²	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	0.00	-4.50	0.000	-2.836	12.250	20.250	85.53	0.00	38.757	124.29	10.37	0.00
2	0.63	3.50	-4.50	2.206	-2.836	0.000	20.250	85.53	0.00	38.757	124.29	10.37	0.00
3	0.63	7.00	-4.50	4.412	-2.836	12.250	20.250	85.53	0.00	38.757	124.29	10.37	0.00
1	0.63	0.00	0.00	0.000	0.000	12.250	0.000	0.00	0.00	38.757	38.76	10.37	0.00
2	0.63	3.50	0.00	2.206	0.000	0.000	0.000	0.00	0.00	38.757	38.76	10.37	0.00
3	0.63	7.00	0.00	4.412	0.000	12.250	0.000	0.00	0.00	38.757	38.76	10.37	0.00
1	0.63	0.00	4.50	0.000	2.836	12.250	20.250	-85.53	0.00	38.757	-46.78	10.37	0.00
2	0.63	3.50	4.50	2.206	2.836	0.000	20.250	-85.53	0.00	38.757	-46.78	10.37	0.00
3	0.63	7.00	4.50	4.412	2.836	12.250	20.250	-85.53	0.00	38.757	-46.78	10.37	0.00
9	5.67			19.85	0.00						124.29 -46.78	10.37 10.37	

$$X_{C.G.} = \Sigma A_p X_i / \Sigma A_p = 19.85 / 5.67 = 3.500 \text{ ft.} \quad Y_{C.G.} = \Sigma A_p Y_i / \Sigma A_p = 0.00 / 5.67 = 0.000 \text{ ft.}$$

$$\Sigma (X_i - X_{C.G.})^2 = 74 \text{ ft.}^2 \quad \Sigma (Y_i - Y_{C.G.})^2 = 121.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (10.37^2 + 0.00^2)^{0.5} = 10.37 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No:	
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Subject:	Wingwall Type 1 - 10.75 Dia. Micropile	Prepared by: SL	Date: 5/2023
Detail:	Summary of Micropile Resistance	Checked by: JG	Date: 5/2023

Summary of Micropile Resistance - Wingwall Type 1

Steel Casing: 10.75 in. O.D. x 0.595 in., $F_y = 52$ ksi, Wall Thickness = 0.595 in.

Steel Reinforcing Bar: #14, Threaded, Grade 60

Compressive strength of micropile grout at 28 days: $f_c = 5$ ksi

Rock Socket Diameter = 9.56 in.

Estimated Bonded Length into Rock (Grout into intact bedrock) = 7.0 ft.

Plunge Length (Casing into Intact Bedrock) = 1 ft

Nominal Geotechnical Pile Resistance per Pile = 378.4 kips

Side Resistance Factor, ϕ_{stat} = 0.55

Factored Geotechnical Pile Resistance per Pile = 208.1 kips > 172.1 k OK

Nominal Uplift Resistance per Pile = 189.2 kips

Resistance Factor, ϕ_{up} = 0.55

Factored Uplift Resistance per Pile = 104.1 kips > 94.5 k OK

Nominal Structural Pile Resistance per Pile = 1096.9 k (Portion of Cased Length)

Nominal Structural Pile Resistance per Pile = 366.0 k (Portion of Uncased Length)

Compression Resistance Factor, ϕ_c = 0.75

Factored Structural Pile Resistance per Pile = 822.7 k (Portion of Cased Length)

Factored Structural Pile Resistance per Pile = 274.5 k (Portion of Uncased Length)

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Nominal Tension Resistance = 995.0 k (Portion of Cased Length)

Nominal Tension Resistance = 135.1 k (Portion of Uncased Length)

Tension Resistance Factor, ϕ_T = 0.8

Factored Tension Resistance = 796.0 k (Portion of Cased Length)

Factored Tension Resistance = 108.1 k (Portion of Uncased Length)

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Subject:	Wingwall Type 1 - 10.75 Dia. Micropile	Prepared by: SL	Date: 5/2023
Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

Axial Compression Resistance

Based on Boring BB-1 $O.D. = 10.75$ in. $t_{wall} = 0.595$ in.

$$R_R = \text{Factored Resistance of a micropile}$$

$$= \phi R_n = \phi_{qp} R_p + \phi_{qs} R_s$$

in which:

$$R_p = q_p A_p$$

$$R_s = q_s A_s$$

where:

$$R_p = \text{nominal tip resistance}$$

(Per AASHTO C10.9.3.5.1, tip resistance is neglected for conservative)

$$R_s = \text{nominal grout to ground bond resistance}$$

$$\phi_{qp} = \text{resistance factor for tip resistance}$$

$$= 0.50 \quad (\text{AASHTO 10.5.5.2.5-1})$$

Note: Tip resistance not included in pile resistance calculation.

$$\phi_{qs} = \text{resistance factor for grout-to-ground resistance}$$

$$= 0.55 \quad (\text{AASHTO 10.5.5.2.5-1})$$

$$d_p = \text{diameter of micropile tip}$$

$$= 9.56 \text{ in.}$$

$$A_p = \text{area of micropile tip} = \pi D^2/4$$

$$= 71.78 \text{ in.}^2 = 0.50 \text{ ft}^2$$

$$R_s = \pi d_b \alpha_b L_b$$

in which:

$$d_b = \text{diameter of micropile drill hole through bonded length}$$

$$= 9.56 \text{ in.} = 0.80 \text{ ft}$$

$$\alpha_b = \text{nominal micropile grout-to-ground bond strength}$$

$$= 21.6 \text{ ksf for Type A Diorite}$$

(AASHTO Table C10.9.3.5.2 - 1)

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Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

$$L_b = \text{micropile bonded length}$$

$$= 7 \text{ ft into Intact Bedrock}$$

$$\phi_{qs} R_s = 0.55 \times 3.141 \times 0.8 \times [21.6 \times 7]$$

$$= 208.1 \text{ kips}$$

$$R_n = 208.13 / 0.55 = \underline{378 \text{ kips}}$$

$$R_R = \underline{208 \text{ kips}}$$

Uplift Resistance

$$\text{Uplift Resistance} = 50 \% \text{ of the compression resistance}$$

$$= 0.5 \times 208.1 = \underline{104 \text{ kips}}$$

$$\phi_{up} = \text{resistance factor}$$

$$= 0.55$$

$$\text{Nominal Resistance} = 104.1 / 0.55 = \underline{189 \text{ kips}}$$

Structural Resistance

Axial Compression Resistance

$$R_C = \text{Factored Structural Resistance of a micropile}$$

$$= \phi_c R_n$$

in which:

$$\phi_C = \text{resistance factor for tip resistance}$$

$$= 0.75 \quad (\text{AASHTO 10.5.5.2.5-2})$$

$$R_n = \text{Nominal axial compression resistance}$$

• For the cased length

$$F_y = 52 \text{ ksi}$$

$$f_y = 60 \text{ ksi} \quad (\text{Reinforcing Bar Grade 60})$$

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Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

$$R_n = 0.85 [0.85 f_c A_g + f_y (A_b + A'_c)]$$

where:

$$f_c = \text{specified compressive strength of micropile grout at 28 days}$$

$$= 5.0 \text{ ksi}$$

$$f_y = \text{specified minimum yield strength of reinforcement bar or steel casing, or stress in steel reinforcement bar or casing at a strain of 0.003, whichever is less}$$

$$\text{Min. } (F_y, f_y) = 52.0 \text{ ksi}$$

$$d_b = 1.69 \text{ in. } \#14 \text{ threaded bar}$$

$$A_b = \text{cross-section area of steel reinforcing bar}$$

$$= 2.25 \text{ in.}^2$$

$$A_c = \text{cross-section area of steel casing}$$

$$= 18.98 \text{ in.}^2$$

$$A'_c = \text{cross-section area of steel casing with 1/16" section loss on outside of the casing}$$

$$= 16.9 \text{ in.}^2 \quad \text{Section loss} = 0.063 \text{ in.}$$

$$A_g = \text{cross-section area of grout within micropile}$$

$$= A_{ID} - A_b = 71.78 - 2.25$$

$$= 69.53 \text{ in.}^2$$

$$R_n = 0.85 \times [0.85 \times 5 \times 69.53 + 52 \times (2.25 + 16.88)]$$

$$= 1096.9 \text{ kips}$$

$$R_{CC} = 0.75 \times 1096.9 = \underline{\underline{823 \text{ kips}}}$$

• For the uncased length

$$R_n = 0.85 [0.85 f_c A_g + f_y A_b]$$

$$f_y = \text{specified minimum yield strength of reinforcement bar or stress in steel reinforcement bar at a strain of 0.003, whichever is less}$$

$$= 60.0 \text{ ksi}$$

$$= 60 \text{ ksi}$$

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$$\begin{aligned}
 R_n &= 0.85 \times [0.85 \times 5 \times 69.53 + 60 \times 2.25] \\
 &= 366.0 \quad \text{kips}
 \end{aligned}$$

$$R_{CU} = 0.75 \times 366 = \underline{274 \text{ kips}}$$

Axial Tension Resistance

$$\begin{aligned}
 R_T &= \text{factored Structural Resistance of a micropile} \\
 &= \phi_T R_n
 \end{aligned}$$

in which:

$$\begin{aligned}
 \phi_T &= \text{resistance factor for tip resistance} \\
 &= 0.80 \quad \text{(AASHTO 10.5.5.2.5-2)}
 \end{aligned}$$

$$R_n = \text{nominal axial tension resistance}$$

• For the cased length

$$\begin{aligned}
 R_n &= f_y (A_b + A'_c)] \\
 &= 52 \times (2.25 + 16.88) = 995.0 \text{ kips}
 \end{aligned}$$

$$R_{TC} = 0.8 \times 995 = \underline{796 \text{ kips}}$$

• For the uncased length

$$\begin{aligned}
 R_n &= f_y A_b \\
 &= 60 \times 2.25 = 135.1 \text{ kips}
 \end{aligned}$$

$$R_{TU} = 0.8 \times 135.1 = \underline{108 \text{ kips}}$$

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Detail:	Lpile Analysis	Checked by: JG	Date: 5/2023

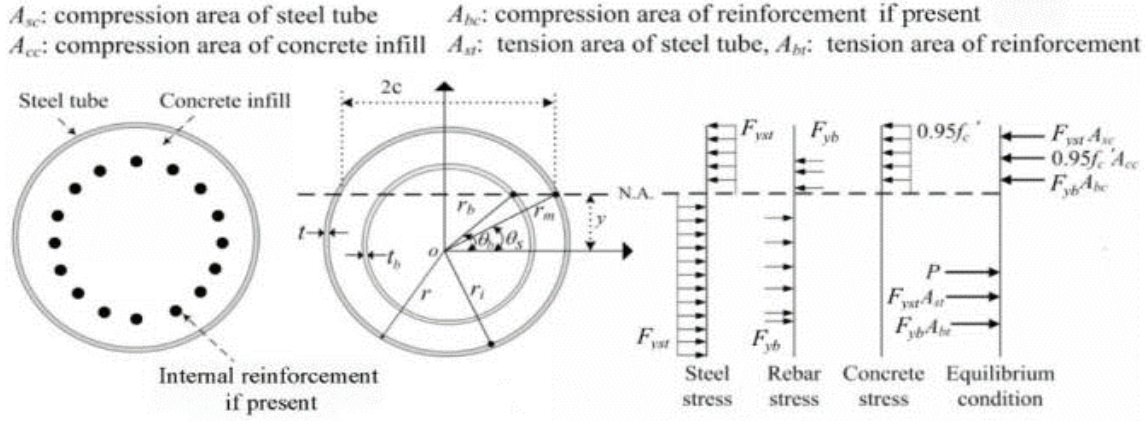


Figure C6.12.2.3.3-1—PSDM Model

$$\begin{aligned}
 P_n = & F_{yt} t r_m \left[(\pi - 2\theta_s) - (\pi + 2\theta_s) \right] \\
 & + t_b r_b \left[F_{yb} (\pi - 2\theta_b) - (F_{yb} - 0.95f'_c) (\pi + 2\theta_b) \right] \\
 & + \frac{0.95f'_c}{2} \left[(\pi - 2\theta_s) r_i^2 - 2yc \right]
 \end{aligned}
 \tag{C6.12.2.3.3-1}$$

$$M_n = 0.95f'_c c \left[(r_i^2 - y^2) - \frac{c^2}{3} \right] + 4F_{yt} t c \frac{r_m^2}{r_i} + 4F_{yb} t_b c_b r_b
 \tag{C6.12.2.3.3-2}$$

in which:

$$r_m = r - \frac{t}{2}
 \tag{C6.12.2.3.3-3}$$

$$\theta_s = \sin^{-1} \left(\frac{y}{r_m} \right)
 \tag{C6.12.2.3.3-4}$$

$$\theta_b = \sin^{-1} \left(\frac{y}{r_b} \right)
 \tag{C6.12.2.3.3-5}$$

$$c = r_i \cos \theta_s
 \tag{C6.12.2.3.3-6}$$

$$c_b = r_b \cos \theta_b
 \tag{C6.12.2.3.3-7}$$

$$t_b = \frac{nA_b}{2\pi r_b}
 \tag{C6.12.2.3.3-8}$$

LAMSON ENGINEERING CORPORATION				Final Page No:	
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Yield Strength, $F_{yst} = 52.00$ ksi
 Strength of Concrete, $f'_c = 5.00$ ksi
 Resistance factor for CFST in compression, $\phi_c = 0.90$ (AASHTO 6.5.4.2)
 Yield Strength, $F_{yb} = 60.00$ ksi
 (AASHTO 6.9.6.2 Limitations) $D/t = 20.0 < 0.15 E / F_{yst} = 83.7$ **OK**
 Concrete shall be greater than 3 ksi or $0.075 F_{yst} = 3.9$ ksi < 5.00 ksi **OK**

$A_s = 2.25$ in² Cover = 3.934 in.
 $r = 5.313$ in. $t = 0.5325$ in.
 $r_m = 5.046$ in.
 $r_i = 4.780$ in.
 $r_b = 0.000$ in. Internal reinforcement is not considered.
 Number of reinforcing bars, $n = 1.0$
 $t_b = n A_s / (2 \pi r_b) = 0$ in.

Strength I

Factored Moment = 108.5 k-ft from Lpile
 Factored Axial Load = 172.1 k from Lpile

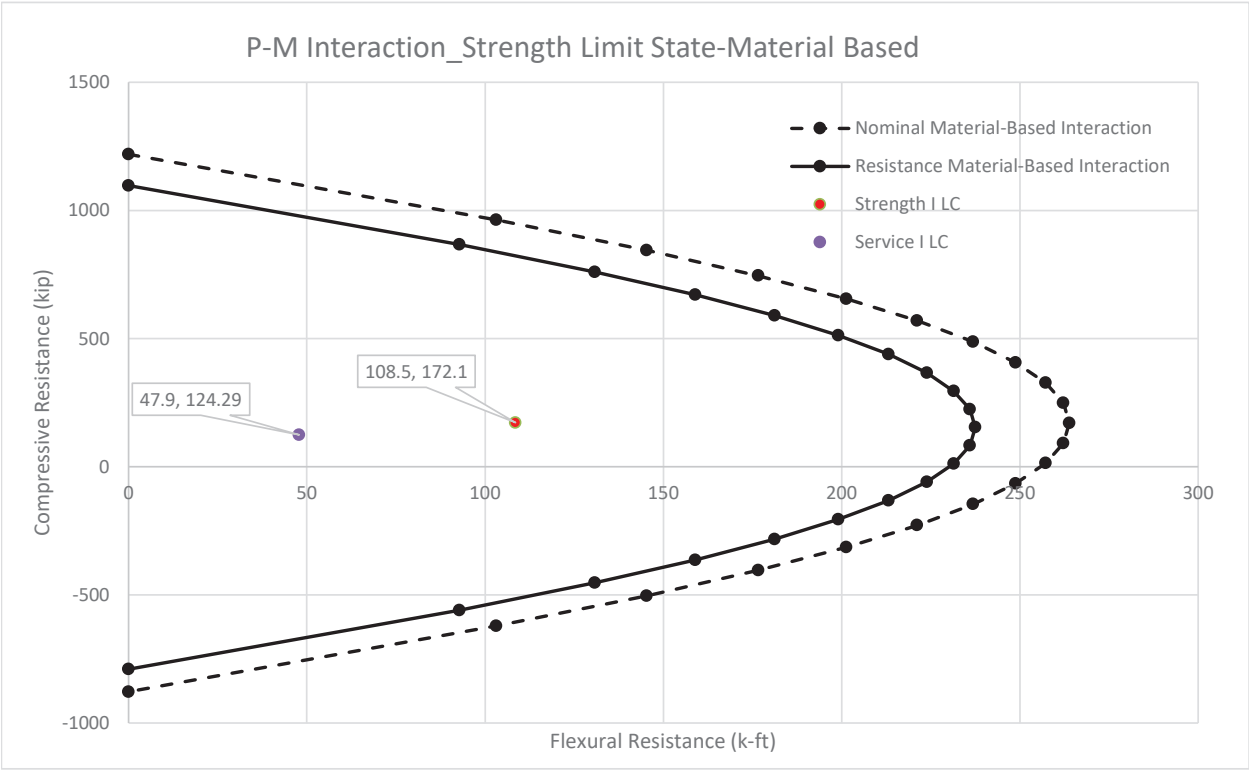
Service I

Factored Moment = 47.9 k-ft from Lpile
 Factored Axial Load = 124.29 k from Lpile

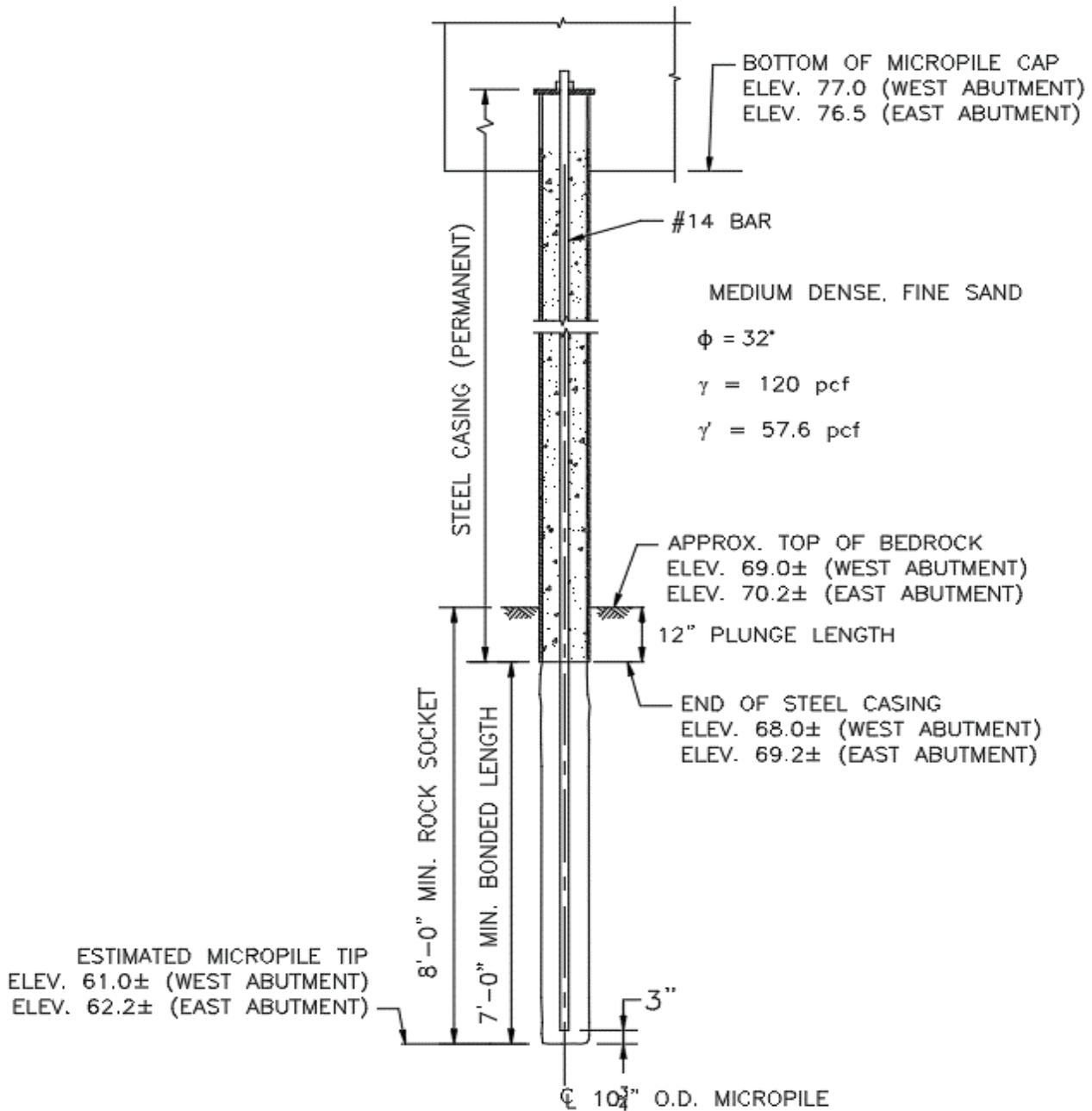
Composite Concrete-Filled Steel Tubes (CFSTs) (AASHTO LRFD 6.12.2.3.3)

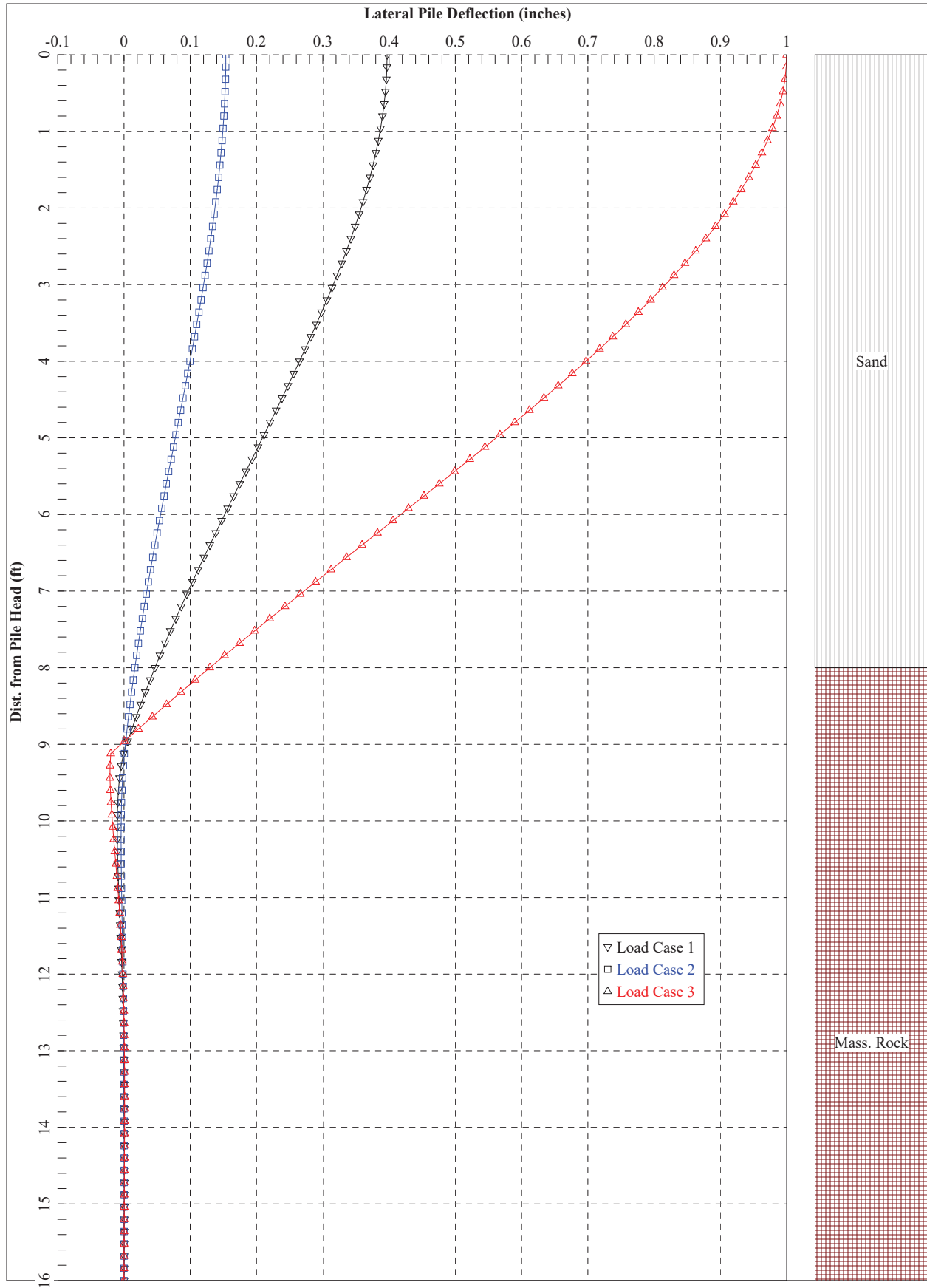
y (in.)	θ_s (rad)	θ_b (rad)	$c = r_i \cos \theta_b$	$c_b = r_b \cos \theta_b$	$\pi - 2 \theta_s$	$\pi + 2 \theta_s$	M_n (kips-ft)	P_n (kips)	$\phi_c M_n$ (kips-ft)	$\phi_c P_n$ (kips)
-5.05	-1.57	-1.57	0.00	0.00	6.28	0.00	0.00	1218.91	0.00	1097.02
-4.54	-1.12	-1.57	2.08	0.00	5.38	0.90	103.09	962.82	92.78	866.54
-4.04	-0.93	-1.57	2.87	0.00	5.00	1.29	145.35	844.40	130.81	759.96
-3.53	-0.78	-1.57	3.41	0.00	4.69	1.59	176.62	745.30	158.95	670.77
-3.03	-0.64	-1.57	3.82	0.00	4.43	1.85	201.36	654.98	181.23	589.48
-2.52	-0.52	-1.57	4.14	0.00	4.19	2.09	221.20	569.57	199.08	512.61
-2.02	-0.41	-1.57	4.38	0.00	3.96	2.32	236.88	487.15	213.19	438.44
-1.51	-0.30	-1.57	4.56	0.00	3.75	2.53	248.81	406.64	223.93	365.97
-1.01	-0.20	-1.57	4.68	0.00	3.54	2.74	257.20	327.33	231.48	294.59
-0.50	-0.10	-1.57	4.76	0.00	3.34	2.94	262.20	248.74	235.98	223.86
0.00	0.00	1.57	4.78	0.00	3.14	3.14	263.86	170.48	237.47	153.43
0.50	0.10	1.57	4.76	0.00	2.94	3.34	262.20	92.22	235.98	83.00
1.01	0.20	1.57	4.68	0.00	2.74	3.54	257.20	13.63	231.48	12.27
1.51	0.30	1.57	4.56	0.00	2.53	3.75	248.81	-65.68	223.93	-59.11
2.02	0.41	1.57	4.38	0.00	2.32	3.96	236.88	-146.19	213.19	-131.57
2.52	0.52	1.57	4.14	0.00	2.09	4.19	221.20	-228.61	199.08	-205.75
3.03	0.64	1.57	3.82	0.00	1.85	4.43	201.36	-314.02	181.23	-282.62
3.53	0.78	1.57	3.41	0.00	1.59	4.69	176.62	-404.34	158.95	-363.90
4.04	0.93	1.57	2.87	0.00	1.29	5.00	145.35	-503.44	130.81	-453.10
4.54	1.12	1.57	2.08	0.00	0.90	5.38	103.09	-621.86	92.78	-559.68
5.05	1.57	1.57	0.00	0.00	0.00	6.28	0.00	-877.95	0.00	-790.16

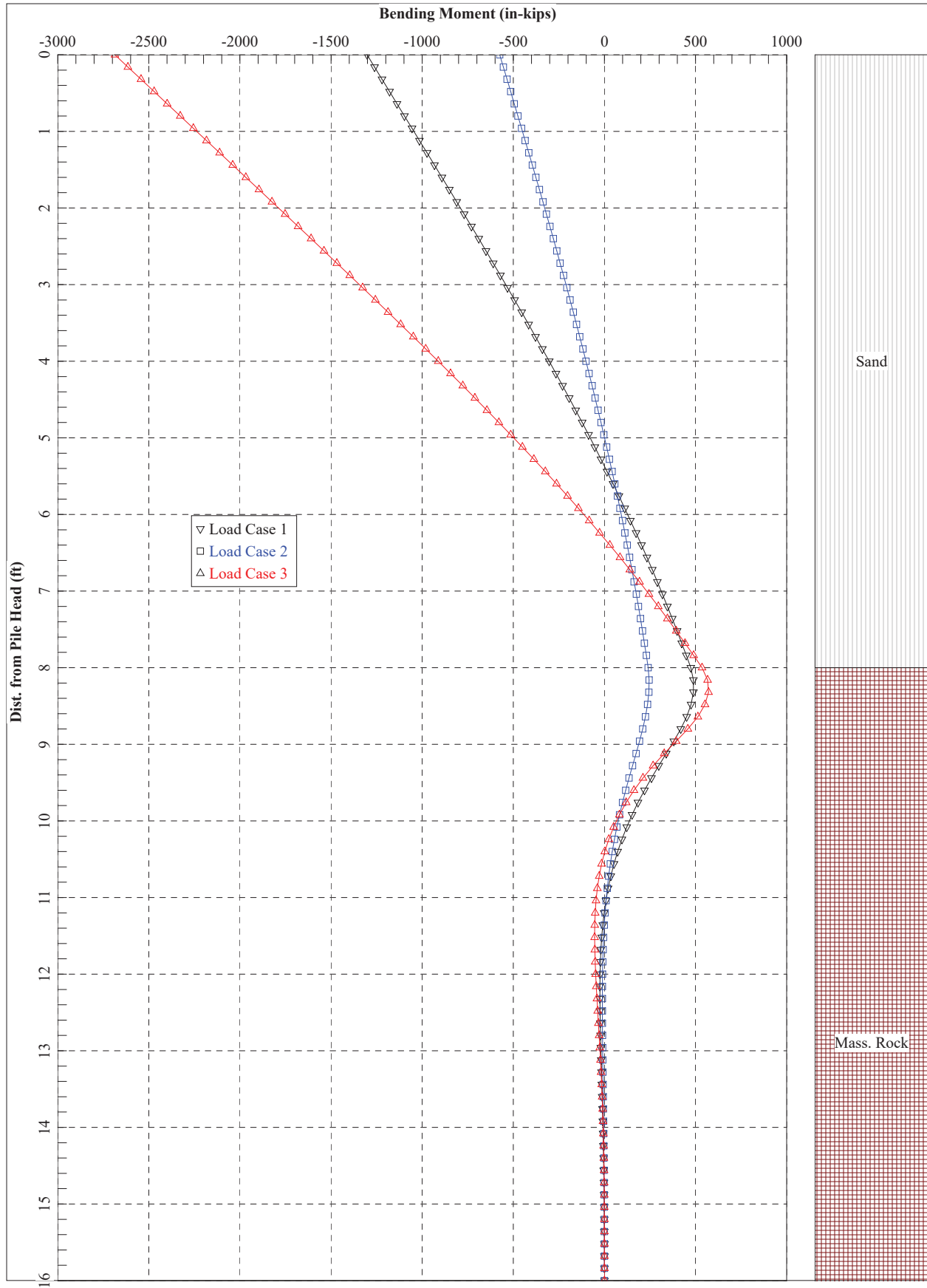
LAMSON ENGINEERING CORPORATION			Final Page No:	
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Subject:	Wingwall Micropile Foundation	Prepared by: SL	Date:	5/2023
Detail:	Lpile Analysis	Checked by: JG	Date:	5/2023

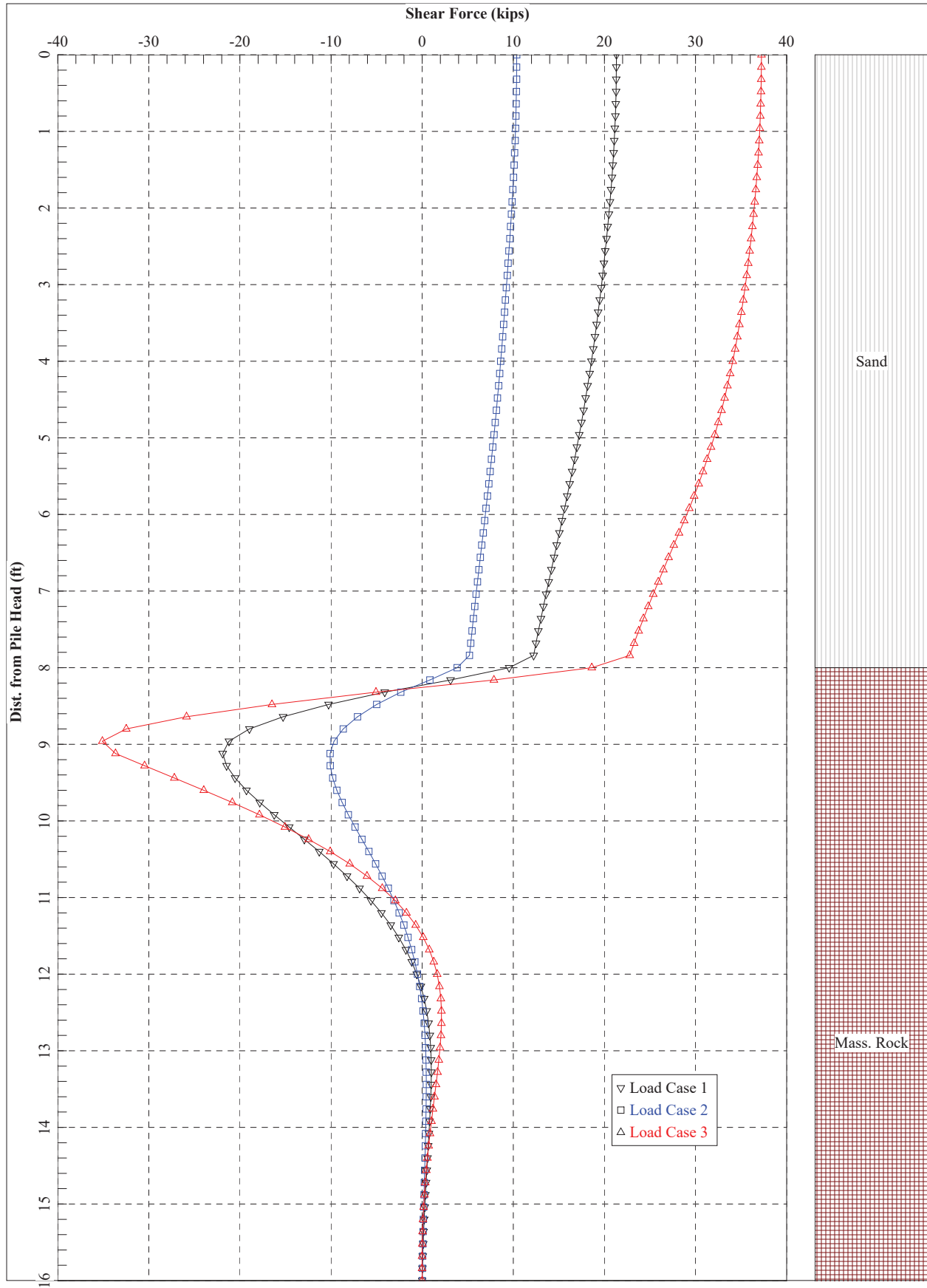


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LPILE for Windows, Version 2022-12.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:
\\Users\Lamson Engineering\Desktop\Charlie's Lamson Files\Green\W-38-003 (2NV) - Wilmington\5.2 Geotech Report -
Bridge & Wingwall Rev\LPILE\

Name of input data file:
Wilmington W38003_Wingwall Type 1 Micropile.lp12d

Name of output report file:
Wilmington W38003_Wingwall Type 1 Micropile.lp12o

Name of plot output file:
Wilmington W38003_Wingwall Type 1 Micropile.lp12p

Name of runtime message file:
Wilmington W38003_Wingwall Type 1 Micropile.lp12r

Date and Time of Analysis

Date: December 15, 2022 Time: 12:37:00

Problem Title

Butters Row Bridge W-38-003, Wilmington

Job Number:

Client: MassDOT

Engineer: Lamson Engineering Corporation

Description: Wingwall Type 2A - 10.75 Dia. Micropile

Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 16.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	10.7500
2	9.000	10.7500
3	9.000	9.5600

4 16.000 9.5600

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with permanent casing
 Length of section = 9.000000 ft
 Casing outside diameter = 10.750000 in

Pile Section No. 2:

Section 2 is a round drilled shaft, bored pile, or CIDH pile
 Length of section = 7.000000 ft
 Shaft Diameter = 9.560000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians
 Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
 Distance from top of pile to bottom of layer = 8.000000 ft
 Effective unit weight at top of layer = 57.600000 pcf
 Effective unit weight at bottom of layer = 57.600000 pcf
 Friction angle at top of layer = 32.000000 deg.
 Friction angle at bottom of layer = 32.000000 deg.
 Subgrade k at top of layer = 60.000000 pci
 Subgrade k at bottom of layer = 60.000000 pci

Layer 2 is massive rock, p-y criteria by Liang et al., 2009

Distance from top of pile to top of layer = 8.000000 ft
 Distance from top of pile to bottom of layer = 20.500000 ft
 Effective unit weight at top of layer = 164.000000 pcf
 Effective unit weight at bottom of layer = 164.000000 pcf
 Uniaxial compressive strength at top of layer = 23836. psi
 Uniaxial compressive strength at bottom of layer = 23836. psi
 Poisson's ratio at top of layer = 0.090000
 Poisson's ratio at bottom of layer = 0.090000
 Option 1: Intact rock modulus at top of layer = 2480000. psi
 Intact rock modulus at bottom of layer = 2480000. psi
 Option 1: Geologic Strength Index for layer = 35.000000
 Option 2: Rock mass modulus at top of layer = 0.0000 psi
 Rock mass modulus at bottom of layer = 0.0000 psi
 Option 1 will be used to compute values of rock mass modulus for the p-y curve
 in massive rock.
 The rock type is (igneous) diorite, Hoek-Brown Material Constant $m_i = 25$

(Depth of the lowest soil layer extends 4.500 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 164.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Geologic Num. Strength Index	Soil Type Int. Rock Name Modulus (p-y Curve Type) psi	Hoek-Brown Material Index, mi	Layer Depth ft	Effective Unit Wt. Poisson's pcf Ratio	Angle of Friction deg.	Uniaxial qu psi	kpy pci	Rock Mass Modulus psi
1	Sand 0.00 (Reese, et al.) 0.00	0.00	0.00	57.6000	32.0000	--	60.0000	--
			8.0000	57.6000	32.0000	--	60.0000	--
2	Massive 2480000. Rock 2480000.	25.0000	8.0000	164.0000	--	23836.	--	Internally
35.0000			20.5000	164.0000	--	23836.	--	Computed
35.0000		25.0000	0.09000					

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.7000	1.0000
2	8.000	0.7000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis

Proposal No. 608929 - 123406

1	2	V =	21320. lbs	S =	0.0000 in/in	169870.	Yes	Yes
2	2	V =	10370. lbs	S =	0.0000 in/in	122470.	Yes	Yes
3	5	y =	1.000000 in	S =	0.0000 in/in	122470.	N.A.	Yes

V = shear force applied normal to pile axis

M = bending moment applied to pile head

y = lateral deflection normal to pile axis

S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head

Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).

Thrust force is assumed to be acting axially for all pile batter angles.

----- Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness -----

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	9.000000 ft
Outer Diameter of Casing	=	10.750000 in
Concrete Cover Thickness Inside Casing	=	3.655000 in
Casing Wall Thickness	=	0.595000 in
Moment of Inertia of Steel Casing	=	245.530255 in^4
Yield Stress of Casing	=	52000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	1 bar
Area of Single Reinforcing Bar	=	2.250000 sq. in.
Edge-to-Edge Bar Spacing	=	-1.69300 in
Maximum Concrete Aggregate Size	=	0.375000 in
Ratio of Bar Spacing to Aggregate Size	=	-4.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Pile	=	90.762575 sq. in.
Area of Concrete	=	69.530366 sq. in.
Cross-sectional Area of Steel Casing	=	18.982210 sq. in.
Area of All Steel (Casing and Bars)	=	21.232210 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	23.39 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = $0.85 F_c A_c + F_y A_s$	=	1417.579 kips
Tensile Load for Cracking of Concrete	=	-103.016 kips
Nominal Axial Tensile Capacity	=	-1122.075 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
-----	-----	-----	-----	-----
1	1.693000	2.250000	0.00000	0.00000

NOTE: The positions of the above rebars were computed by LPile

Concrete Properties:

Compressive Strength of Concrete = 5000. psi
 Modulus of Elasticity of Concrete = 4030509. psi
 Modulus of Rupture of Concrete = -530.33009 psi
 Compression Strain at Peak Stress = 0.002109
 Tensile Strain at Fracture of Concrete = -0.0001150
 Maximum Coarse Aggregate Size = 0.375000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	122.470
2	169.870

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
 Y = stress in reinforcing steel has reached yield stress.
 T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
 Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
 Position of neutral axis is measured from edge of compression side of pile.
 Compressive stresses and strains are positive in sign.
 Tensile stresses and strains are negative in sign.

Axial Thrust Force = 122.470 kips

Bending Max Casing Run Curvature Stress Msg rad/in. ksi	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi
0.00000125	11.1943809	8955505.	110.1409414	0.0001377	0.0001242	0.6312223	3.8269919
3.9906607							
0.00000250	22.3872211	8954888.	57.7588979	0.0001444	0.0001175	0.6606650	3.8562857
4.1836232							
0.00000375	33.5800506	8954680.	40.2986318	0.0001511	0.0001108	0.6900150	3.8856247
4.3766309							
0.00000500	44.7728641	8954573.	31.5688099	0.0001578	0.0001041	0.7192722	3.9150087
4.5696837							
0.00000625	55.9656561	8954505.	26.3311657	0.0001646	0.00009738	0.7484366	3.9444379
4.7627816							
0.00000750	67.1584213	8954456.	22.8396104	0.0001713	0.00009067	0.7775081	3.9739122
4.9559247							
0.00000875	78.3511543	8954418.	20.3458202	0.0001780	0.00008396	0.8064866	4.0034316
5.1491128							
0.00001000	89.5438497	8954385.	18.4756332	0.0001848	0.00007726	0.8353720	4.0329961
5.3423461							
0.00001125	100.7365021	8954356.	17.0211815	0.0001915	0.00007055	0.8641643	4.0626058
5.5356246							
0.00001250	111.9291063	8954329.	15.8577447	0.0001982	0.00006385	0.8928635	4.0922606
5.7289481							
0.00001375	123.1216567	8954302.	14.9059551	0.0002050	0.00005714	0.9214694	4.1219606
5.9223168							

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0.00001500	134.3141481	8954277.	14.1129008	0.0002117	0.00005044	0.9499819	4.1517056
6.1157306							
0.00001625	145.5065751	8954251.	13.4419506	0.0002184	0.00004374	0.9784011	4.1814958
6.3091896							
0.00001750	156.6989322	8954225.	12.8669393	0.0002252	0.00003705	1.0067268	4.2113311
6.5026936							
0.00001875	167.8912141	8954198.	12.3686793	0.0002319	0.00003035	1.0349590	4.2412116
6.6962428							
0.00002000	179.0834154	8954171.	11.9327795	0.0002387	0.00002366	1.0630975	4.2711372
6.8898372							
0.00002125	190.2755308	8954143.	11.5482353	0.0002454	0.00001696	1.0911424	4.3011079
7.0834766							
0.00002250	201.4675548	8954114.	11.2064874	0.0002521	0.00001027	1.1190935	4.3311237
7.2771612							
0.00002375	212.6594822	8954083.	10.9007785	0.0002589	0.00000358	1.1469509	4.3611847
7.4708909							
0.00002500	223.8513074	8954052.	10.6257027	0.0002656	-0.00000311	1.1747143	4.3912908
7.6646658							
0.00002625	235.0430252	8954020.	10.3768839	0.0002724	-0.00000979	1.2023838	4.4214420
7.8584858							
0.00002750	246.2346302	8953987.	10.1507416	0.0002791	-0.00001648	1.2299592	4.4516384
8.0523509							
0.00002875	257.4260775	8953951.	9.9443177	0.0002859	-0.00002316	1.2574405	4.4818797
8.2462609							
0.00003000	268.6171144	8953904.	9.7551454	0.0002927	-0.00002985	1.2848274	4.5121641
8.4402141							
0.00003125	279.8073573	8953835.	9.5811516	0.0002994	-0.00003653	1.3121194	4.5424890
8.6342078							
0.00003250	290.9964035	8953735.	9.4205818	0.0003062	-0.00004321	1.3393160	4.5728515
8.8282390							
0.00003375	302.1838828	8953597.	9.2719415	0.0003129	-0.00004988	1.3664169	4.6032488
9.0223051							
0.00003500	313.3694469	8953413.	9.1339501	0.0003197	-0.00005656	1.3934215	4.6336782
9.2164032							
0.00003625	324.5527934	8953181.	9.0055034	0.0003264	-0.00006324	1.4203294	4.6641371
9.4105308							
0.00003750	335.7336521	8952897.	8.8856449	0.0003332	-0.00006991	1.4471404	4.6946233
9.6046858							
0.00003875	346.9117838	8952562.	8.7735416	0.0003400	-0.00007659	1.4738540	4.7251347
9.7988659							
0.00004000	358.0869780	8952174.	8.6684648	0.0003467	-0.00008326	1.5004700	4.7556693
9.9930693							
0.00004125	369.2590507	8951735.	8.5697744	0.0003535	-0.00008993	1.5269882	4.7862256
10.1872943							
0.00004250	380.4278407	8951243.	8.4769056	0.0003603	-0.00009661	1.5534082	4.8168018
10.3815393							
0.00004375	391.5932058	8950702.	8.3893581	0.0003670	-0.000103	1.5797298	4.8473967
10.5758030							
0.00004500	402.7550193	8950112.	8.3066878	0.0003738	-0.000110	1.6059529	4.8780089
10.7700839							
0.00004625	406.6523406	8792483.	8.1849768	0.0003786	-0.000119	1.6242392	4.8502643
10.9060081 C							
0.00004750	416.9441247	8777771.	8.1066178	0.0003851	-0.000126	1.6492918	4.8734130
11.0928255 C							
0.00004875	427.1974004	8763024.	8.0319985	0.0003916	-0.000133	1.6741986	4.8961677
11.2792489 C							
0.00005125	447.6270943	8734187.	7.8931579	0.0004045	-0.000146	1.7236307	4.9409014
11.6513202 C							
0.00005375	467.9495215	8706038.	7.7665016	0.0004174	-0.000160	1.7725430	4.9844954
12.0222517 C							
0.00005625	488.1876945	8678892.	7.6505474	0.0004303	-0.000174	1.8209692	5.0271822
12.3922760 C							
0.00005875	508.3513816	8652789.	7.5439793	0.0004432	-0.000188	1.8689230	5.0690471
12.7614783 C							
0.00006125	528.4500238	8627755.	7.4456999	0.0004560	-0.000202	1.9164186	5.1101825
13.1299512 C							
0.00006375	548.4926414	8603806.	7.3547877	0.0004689	-0.000216	1.9634710	5.1506875
13.4977937 C							
0.00006625	568.4787327	8580811.	7.2703877	0.0004817	-0.000231	2.0100767	5.1905217

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13.8649654 C							
0.00006875	588.4157941	8558775.	7.1918301	0.0004944	-0.000245	2.0562481	5.2297661
14.2315473 C							
0.00007125	608.3173597	8537788.	7.1185971	0.0005072	-0.000259	2.1020118	5.2686217
14.5977404 C							
0.00007375	628.1847685	8517760.	7.0501538	0.0005199	-0.000273	2.1473707	5.3071026
14.9635589 C							
0.00007625	648.0080759	8498467.	6.9859357	0.0005327	-0.000287	2.1923005	5.3450021
15.3287959 C							
0.00007875	667.8134600	8480171.	6.9257444	0.0005454	-0.000301	2.2368597	5.3827862
15.6939174 C							
0.00008125	687.5781662	8462501.	6.8690204	0.0005581	-0.000315	2.2809952	5.4200123
16.0584811 C							
0.00008375	707.3289516	8445719.	6.8156603	0.0005708	-0.000330	2.3247688	5.4571835
16.4229898 C							
0.00008625	727.0447178	8429504.	6.7651995	0.0005835	-0.000344	2.3681296	5.4938696
16.7870134 C							
0.00008875	746.7529451	8414118.	6.7176100	0.0005962	-0.000358	2.4111448	5.5306286
17.1511099 C							
0.00009125	766.4234729	8399161.	6.6724077	0.0006089	-0.000372	2.4537374	5.5668045
17.5146233 C							
0.00009375	786.0872295	8384930.	6.6296489	0.0006215	-0.000386	2.4959871	5.6030691
17.8782253 C							
0.00009625	805.7286782	8371207.	6.5890133	0.0006342	-0.000400	2.5378519	5.6390602
18.2415539 C							
0.00009875	825.3507668	8357982.	6.5503634	0.0006468	-0.000415	2.5793404	5.6748457
18.6046770 C							
0.0001013	844.9660722	8345344.	6.5136521	0.0006595	-0.000429	2.6204862	5.7107191
18.9678879 C							
0.0001038	864.5567960	8333078.	6.4785905	0.0006722	-0.000443	2.6612392	5.7462328
19.3307390 C							
0.0001063	884.1338655	8321260.	6.4451510	0.0006848	-0.000457	2.7016306	5.7816608
19.6935045 C							
0.0001088	903.7041454	8309923.	6.4132765	0.0006974	-0.000472	2.7416798	5.8171759
20.0563571 C							
0.0001113	923.2580950	8298949.	6.3827811	0.0007101	-0.000486	2.7813582	5.8525181
20.4190369 C							
0.0001138	942.7934099	8288294.	6.3535544	0.0007227	-0.000500	2.8206593	5.8876239
20.7814802 C							
0.0001163	962.3219329	8278038.	6.3256105	0.0007354	-0.000514	2.8596185	5.9228162
21.1440100 C							
0.0001188	981.8436556	8268157.	6.2988683	0.0007480	-0.000529	2.8982356	5.9580953
21.5066265 C							
0.0001213	1001.	8258535.	6.2731591	0.0007606	-0.000543	2.9364753	5.9931288
21.8689976 C							
0.0001238	1021.	8249190.	6.2484535	0.0007732	-0.000557	2.9743508	6.0280364
22.2312426 C							
0.0001263	1040.	8240161.	6.2247500	0.0007859	-0.000571	3.0118844	6.0630302
22.5935739 C							
0.0001288	1060.	8231430.	6.2019900	0.0007985	-0.000586	3.0490758	6.0981104
22.9559916 C							
0.0001313	1079.	8222973.	6.1801133	0.0008111	-0.000600	3.0859222	6.1332518
23.3184706 C							
0.0001338	1099.	8214678.	6.1589595	0.0008238	-0.000614	3.1223802	6.1680218
23.6805780 C							
0.0001363	1118.	8206638.	6.1386038	0.0008364	-0.000628	3.1584965	6.2028818
24.0427755 C							
0.0001388	1138.	8198839.	6.1190030	0.0008490	-0.000643	3.1942706	6.2378280
24.4050593 C							
0.0001413	1157.	8191267.	6.1001172	0.0008616	-0.000657	3.2297021	6.2728606
24.7674294 C							
0.0001438	1176.	8183911.	6.0819091	0.0008743	-0.000671	3.2647910	6.3079797
25.1298860 C							
0.0001463	1196.	8176718.	6.0642910	0.0008869	-0.000685	3.2995155	6.3429614
25.4922051 C							
0.0001488	1215.	8169686.	6.0472409	0.0008995	-0.000700	3.3338791	6.3778386
25.8544198 C							
0.0001588	1293.	8143341.	5.9845988	0.0009501	-0.000757	3.4679044	6.5182127
27.3041440 C							

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0.0001688	1370.	8119327.	5.9294630	0.0010006	-0.000813	3.5963456	6.6589886
28.7542699 C							
0.0001788	1447.	8097322.	5.8806755	0.0010512	-0.000870	3.7192415	6.8006936
30.2053248 C							
0.0001888	1525.	8076993.	5.8371964	0.0011018	-0.000927	3.8365681	6.9431584
31.6571397 C							
0.0001988	1602.	8058087.	5.7982293	0.0011524	-0.000984	3.9483186	7.0864113
33.1097426 C							
0.0002088	1678.	8040459.	5.7632292	0.0012031	-0.001041	4.0545284	7.2310785
34.5637598 C							
0.0002188	1755.	8023879.	5.7315464	0.0012538	-0.001098	4.1551359	7.3764902
36.0185214 C							
0.0002288	1832.	8008228.	5.7027899	0.0013045	-0.001155	4.2501509	7.5229380
37.4743192 C							
0.0002388	1908.	7993417.	5.6766501	0.0013553	-0.001211	4.3395853	7.6708236
38.9315549 C							
0.0002488	1985.	7979343.	5.6528123	0.0014061	-0.001268	4.4234225	7.8201549
40.3902362 C							
0.0002588	2061.	7965889.	5.6309411	0.0014570	-0.001325	4.5016192	7.9704175
41.8498487 C							
0.0002688	2137.	7952994.	5.6108398	0.0015079	-0.001381	4.5741729	8.1217880
43.3105693 C							
0.0002788	2213.	7940614.	5.5923628	0.0015589	-0.001438	4.6410866	8.2746311
44.7727623 C							
0.0002888	2289.	7928693.	5.5753425	0.0016099	-0.001494	4.7023433	8.4289550
46.2364362 C							
0.0002988	2365.	7917183.	5.5596335	0.0016609	-0.001551	4.7579260	8.5847682
47.7015994 C							
0.0003088	2441.	7906043.	5.5451094	0.0017121	-0.001607	4.8078174	8.7420792
49.1682605 C							
0.0003188	2517.	7895227.	5.5316343	0.0017632	-0.001663	4.8519936	8.9006623
50.6361936 C							
0.0003288	2592.	7884449.	5.5191605	0.0018144	-0.001720	4.8904506	9.0609766
52.0000000 CY							
0.0003388	2665.	7868590.	5.5090498	0.0018662	-0.001775	4.9234567	9.2372713
52.0000000 CY							
0.0003488	2735.	7843527.	5.5017253	0.0019187	-0.001830	4.9509241	9.4358801
52.0000000 CY							
0.0003588	2799.	7802086.	5.4964397	0.0019718	-0.001885	4.9725180	9.6514514
52.0000000 CY							
0.0003688	2854.	7740984.	5.4921858	0.0020252	-0.001939	4.9879590	9.8749926
52.0000000 CY							
0.0003788	2903.	7663445.	5.4877726	0.0020785	-0.001993	4.9971012	10.0943157
52.0000000 CY							
0.0003888	2944.	7573716.	5.4824258	0.0021313	-0.002048	4.9993424	10.3005536
52.0000000 CY							
0.0003988	2981.	7475869.	5.4763474	0.0021837	-0.002103	4.9988209	10.4952308
52.0000000 CY							
0.0004088	3014.	7373396.	5.4699924	0.0022359	-0.002158	4.9991897	10.6831030
52.0000000 CY							
0.0004188	3044.	7268275.	5.4635229	0.0022879	-0.002214	4.9993720	10.8659001
52.0000000 CY							
0.0004288	3071.	7161850.	5.4570210	0.0023397	-0.002269	4.9994199	11.0445402
52.0000000 CY							
0.0004388	3095.	7055092.	5.4505359	0.0023914	-0.002325	4.9993487	11.2196242
52.0000000 CY							
0.0004488	3118.	6948650.	5.4441400	0.0024431	-0.002381	4.9991398	11.3921081
52.0000000 CY							
0.0004588	3139.	6842653.	5.4381088	0.0024947	-0.002437	4.9987485	11.5657335
52.0000000 CY							
0.0004688	3158.	6738001.	5.4322026	0.0025463	-0.002493	4.9980842	11.7375594
52.0000000 CY							
0.0004788	3177.	6635029.	5.4264008	0.0025979	-0.002549	4.9999774	11.9074104
52.0000000 CY							
0.0004888	3193.	6533461.	5.4208926	0.0026495	-0.002605	4.9998607	12.0780575
52.0000000 CY							
0.0004988	3209.	6433327.	5.4154340	0.0027009	-0.002661	4.9993226	12.2462275
52.0000000 CY							
0.0005088	3223.	6335505.	5.4100822	0.0027524	-0.002717	4.9981861	12.4128057

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52.0000000 CY							
0.0005188	3237.	6239463.	5.4053272	0.0028040	-0.002773	4.9999956	12.5852604
52.0000000 CY							
0.0005288	3249.	6145304.	5.4003801	0.0028555	-0.002829	4.9995130	12.7520093
52.0000000 CY							
0.0005388	3261.	6053188.	5.3957857	0.0029070	-0.002885	4.9980440	12.9214012
52.0000000 CY							
0.0005488	3272.	5963325.	5.3914798	0.0029586	-0.002940	4.9999634	13.0927177
52.0000000 CY							
0.0006088	3327.	5464704.	5.3684931	0.0032681	-0.003276	4.9970187	-14.348205
52.0000000 CY							
0.0006688	3365.	5031987.	5.3512140	0.0035786	-0.003610	4.9999816	-16.097508
52.0000000 CY							
0.0007288	3393.	4656415.	5.3382779	0.0038903	-0.003944	4.9959999	-17.815160
52.0000000 CY							

Axial Thrust Force = 169.870 kips

Bending Max Casing Run Curvature Stress rad/in. ksi	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi
0.00000125	11.1357254	8908580.	151.3164881	0.0001891	0.0001757	0.8563757	5.3196055
5.4832743							
0.00000250	22.2693016	8907721.	78.3466794	0.0001959	0.0001690	0.8850484	5.3488999
5.6762374							
0.00000375	33.4028670	8907431.	54.0238285	0.0002026	0.0001623	0.9136283	5.3782398
5.8692460							
0.00000500	44.5364162	8907283.	41.8627169	0.0002093	0.0001556	0.9421154	5.4076252
6.0623002							
0.00000625	55.6699437	8907191.	34.5663012	0.0002160	0.0001489	0.9705094	5.4370562
6.2553999							
0.00000750	66.8034442	8907126.	29.7022333	0.0002228	0.0001421	0.9988105	5.4665326
6.4485451							
0.00000875	77.9369122	8907076.	26.2280785	0.0002295	0.0001354	1.0270184	5.4960546
6.6417359							
0.00001000	89.0703423	8907034.	23.6226194	0.0002362	0.0001287	1.0551332	5.5256221
6.8349721							
0.00001125	100.2037291	8906998.	21.5962907	0.0002430	0.0001220	1.0831547	5.5552352
7.0282539							
0.00001250	111.3370671	8906965.	19.9753533	0.0002497	0.0001153	1.1110829	5.5848937
7.2215812							
0.00001375	122.4703510	8906935.	18.6492460	0.0002564	0.0001086	1.1389177	5.6145978
7.4149541							
0.00001500	133.6035753	8906905.	17.5442613	0.0002632	0.0001019	1.1666591	5.6443474
7.6083724							
0.00001625	144.7367346	8906876.	16.6093708	0.0002699	0.00009521	1.1943070	5.6741426
7.8018363							
0.00001750	155.8698234	8906847.	15.8081257	0.0002766	0.00008852	1.2218612	5.7039832
7.9953457							
0.00001875	167.0028364	8906818.	15.1137971	0.0002834	0.00008182	1.2493218	5.7338694
8.1889007							
0.00002000	178.1357681	8906788.	14.5063381	0.0002901	0.00007513	1.2766887	5.7638011
8.3825011							
0.00002125	189.2686131	8906758.	13.9704187	0.0002969	0.00006843	1.3039617	5.7937784
8.5761471							
0.00002250	200.4013659	8906727.	13.4941156	0.0003036	0.00006174	1.3311409	5.8238011
8.7698386							
0.00002375	211.5340212	8906696.	13.0680159	0.0003104	0.00005505	1.3582261	5.8538694
8.9635757							
0.00002500	222.6665735	8906663.	12.6845889	0.0003171	0.00004836	1.3852173	5.8839833
9.1573583							
0.00002625	233.7990175	8906629.	12.3377386	0.0003239	0.00004168	1.4121144	5.9141426
9.3511864							

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0.00002750	244.9313476	8906594.	12.0224772	0.0003306	0.00003499	1.4389173	5.9443475
9.5450600							
0.00002875	256.0635584	8906559.	11.7346844	0.0003374	0.00002831	1.4656261	5.9745979
9.7389792							
0.00003000	267.1956446	8906521.	11.4709267	0.0003441	0.00002163	1.4922405	6.0048938
9.9329438							
0.00003125	278.3276007	8906483.	11.2283199	0.0003509	0.00001495	1.5187605	6.0352353
10.1269541							
0.00003250	289.4594213	8906444.	11.0044235	0.0003576	0.00000827	1.5451861	6.0656223
10.3210098							
0.00003375	300.5911009	8906403.	10.7971585	0.0003644	0.00000159	1.5715172	6.0960549
10.5151111							
0.00003500	311.7226341	8906361.	10.6047430	0.0003712	-0.00000508	1.5977537	6.1265330
10.7092580							
0.00003625	322.8540156	8906318.	10.4256408	0.0003779	-0.00001176	1.6238956	6.1570566
10.9034503							
0.00003750	333.9852398	8906273.	10.2585207	0.0003847	-0.00001843	1.6499427	6.1876257
11.0976882							
0.00003875	345.1162990	8906227.	10.1022230	0.0003915	-0.00002510	1.6758950	6.2182404
11.2919717							
0.00004000	356.2471305	8906178.	9.9557329	0.0003982	-0.00003177	1.7017524	6.2489002
11.4863002							
0.00004125	367.3775310	8906122.	9.8181575	0.0004050	-0.00003844	1.7275147	6.2796038
11.6806726							
0.00004250	378.5072238	8906052.	9.6887087	0.0004118	-0.00004510	1.7531814	6.3103493
11.8750868							
0.00004375	389.6359238	8905964.	9.5666884	0.0004185	-0.00005177	1.7787523	6.3411345
12.0695408							
0.00004500	400.7633499	8905852.	9.4514759	0.0004253	-0.00005843	1.8042271	6.3719575
12.2640325							
0.00004625	411.8892336	8905713.	9.3425178	0.0004321	-0.00006510	1.8296053	6.4028162
12.4585599							
0.00004750	423.0133233	8905544.	9.2393187	0.0004389	-0.00007176	1.8548868	6.4337085
12.6531210							
0.00004875	434.1353861	8905341.	9.1414344	0.0004456	-0.00007842	1.8800712	6.4646328
12.8477140							
0.00005125	456.3725891	8904831.	8.9600500	0.0004592	-0.00009173	1.9301476	6.5265698
13.2369886							
0.00005375	478.5993287	8904174.	8.7956075	0.0004728	-0.000105	1.9798325	6.5886143
13.6263706							
0.00005625	495.8337828	8814823.	8.6221266	0.0004850	-0.000120	2.0242465	6.6120707
13.9771645 C							
0.00005875	516.6488727	8794023.	8.4793876	0.0004982	-0.000133	2.0717388	6.6627490
14.3551803 C							
0.00006125	537.3412305	8772918.	8.3476958	0.0005113	-0.000147	2.1187156	6.7123527
14.7321214 C							
0.00006375	557.9201549	8751689.	8.2257776	0.0005244	-0.000161	2.1651863	6.7609300
15.1080362 C							
0.00006625	578.3924027	8730451.	8.1125393	0.0005375	-0.000175	2.2111568	6.8085055
15.4829492 C							
0.00006875	598.7749378	8709454.	8.0071091	0.0005505	-0.000189	2.2566482	6.8552286
15.8570098 C							
0.00007125	619.0728407	8688742.	7.9086754	0.0005635	-0.000202	2.3016659	6.9011211
16.2302398 C							
0.00007375	639.2947293	8668403.	7.8165590	0.0005765	-0.000216	2.3462203	6.9462516
16.6027079 C							
0.00007625	659.4512837	8648541.	7.7301858	0.0005894	-0.000230	2.3903262	6.9907250
16.9745188 C							
0.00007875	679.5515685	8629226.	7.6490511	0.0006024	-0.000244	2.4339968	7.0346378
17.3457690 C							
0.00008125	699.6042190	8610513.	7.5727151	0.0006153	-0.000258	2.4772458	7.0780930
17.7165618 C							
0.00008375	719.5923115	8592147.	7.5006390	0.0006282	-0.000272	2.5200440	7.1208256
18.0866319 C							
0.00008625	739.5399756	8574377.	7.4325806	0.0006411	-0.000286	2.5624302	7.1631565
18.4563003 C							
0.00008875	759.4558846	8557249.	7.3682505	0.0006539	-0.000300	2.6044202	7.2052147
18.8256959 C							
0.00009125	779.3143932	8540432.	7.3071827	0.0006668	-0.000314	2.6459674	7.2465777

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19.1943964 C							
0.00009375	799.1560500	8524331.	7.2493484	0.0006796	-0.000328	2.6871441	7.2878772
19.5630334 C							
0.00009625	818.9466176	8508536.	7.1942914	0.0006925	-0.000342	2.7278876	7.3285428
19.9310366 C							
0.00009875	838.7242864	8493410.	7.1420194	0.0007053	-0.000356	2.7682681	7.3692005
20.2990318 C							
0.0001013	858.4548792	8478567.	7.0921226	0.0007181	-0.000370	2.8082211	7.4092530
20.6664217 C							
0.0001038	878.1785995	8464372.	7.0446624	0.0007309	-0.000384	2.8478236	7.4494017
21.0339079 C							
0.0001063	897.8563122	8450412.	6.9992321	0.0007437	-0.000399	2.8869983	7.4889232
21.4007670 C							
0.0001088	917.5240028	8437002.	6.9559023	0.0007565	-0.000413	2.9258172	7.5284819
21.7676631 C							
0.0001113	937.1667853	8423971.	6.9144398	0.0007692	-0.000427	2.9642492	7.5677822
22.1343009 C							
0.0001138	956.7823561	8411273.	6.8747076	0.0007820	-0.000441	3.0022903	7.6067780
22.5006343 C							
0.0001163	976.3909919	8399062.	6.8367120	0.0007948	-0.000455	3.0399822	7.6458673
22.8670610 C							
0.0001188	995.9680061	8387099.	6.8001935	0.0008075	-0.000469	3.0772723	7.6845337
23.2330650 C							
0.0001213	1016.	8375491.	6.7651491	0.0008203	-0.000483	3.1141930	7.7230886
23.5989573 C							
0.0001238	1035.	8364296.	6.7315463	0.0008330	-0.000497	3.1507649	7.7617357
23.9649419 C							
0.0001263	1055.	8353342.	6.6991855	0.0008458	-0.000511	3.1869468	7.8000572
24.3306010 C							
0.0001288	1074.	8342665.	6.6680337	0.0008585	-0.000526	3.2227537	7.8382008
24.6960821 C							
0.0001313	1094.	8332342.	6.6380926	0.0008712	-0.000540	3.2582124	7.8764357
25.0616545 C							
0.0001338	1113.	8322338.	6.6092828	0.0008840	-0.000554	3.2933182	7.9147169
25.4272732 C							
0.0001363	1133.	8312465.	6.5813995	0.0008967	-0.000568	3.3280178	7.9524818
25.7923756 C							
0.0001388	1152.	8302898.	6.5545435	0.0009094	-0.000582	3.3623695	7.9903372
26.1575684 C							
0.0001413	1171.	8293620.	6.5286603	0.0009222	-0.000596	3.3963730	8.0282831
26.5228519 C							
0.0001438	1191.	8284615.	6.5036989	0.0009349	-0.000610	3.4300280	8.0663184
26.8882247 C							
0.0001463	1210.	8275709.	6.4794671	0.0009476	-0.000625	3.4632785	8.1038295
27.2530732 C							
0.0001488	1230.	8267055.	6.4560708	0.0009603	-0.000639	3.4961812	8.1414305
27.6180117 C							
0.0001588	1307.	8234560.	6.3698899	0.0010112	-0.000695	3.6242454	8.2919981
29.0779294 C							
0.0001688	1385.	8204921.	6.2938952	0.0010621	-0.000752	3.7466003	8.4424296
30.5377108 C							
0.0001788	1462.	8177610.	6.2262958	0.0011130	-0.000809	3.8632144	8.5923034
31.9969346 C							
0.0001888	1539.	8152491.	6.1660030	0.0011638	-0.000865	3.9741936	8.7429588
33.4569400 C							
0.0001988	1616.	8129128.	6.1117859	0.0012147	-0.000922	4.0794778	8.8936699
34.9170011 C							
0.0002088	1692.	8107414.	6.0629406	0.0012656	-0.000978	4.1791337	9.0454540
36.3781353 C							
0.0002188	1769.	8087016.	6.0185926	0.0013166	-0.001035	4.2730942	9.1974372
37.8394685 C							
0.0002288	1846.	8067903.	5.9783414	0.0013675	-0.001092	4.3614304	9.3508759
39.3022571 C							
0.0002388	1922.	8049819.	5.9415351	0.0014185	-0.001148	4.4440735	9.5048198
40.7655511 C							
0.0002488	1998.	8032686.	5.9078292	0.0014696	-0.001204	4.5210435	9.6597824
42.2298637 C							
0.0002588	2074.	8016430.	5.8769255	0.0015207	-0.001261	4.5923498	9.8162215
43.6956528 C							

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0.0002688	2150.	8000920.	5.8484549	0.0015718	-0.001317	4.6579564	9.9736999
45.1624812 C							
0.0002788	2226.	7986052.	5.8221178	0.0016229	-0.001374	4.7178391	10.1319123
46.6300436 C							
0.0002888	2302.	7971810.	5.7977842	0.0016741	-0.001430	4.7720161	10.2916256
48.0991069 C							
0.0002988	2377.	7958127.	5.7752538	0.0017254	-0.001486	4.8204701	10.4528483
49.5696795 C							
0.0003088	2453.	7944947.	5.7543525	0.0017767	-0.001542	4.8631833	10.6155889
51.0417701 C							
0.0003188	2528.	7930913.	5.7351775	0.0018281	-0.001598	4.9001915	10.7821654
52.0000000 CY							
0.0003288	2601.	7910861.	5.7190904	0.0018802	-0.001654	4.9317262	10.9670587
52.0000000 CY							
0.0003388	2669.	7879813.	5.7074436	0.0019334	-0.001708	4.9578081	11.1862407
52.0000000 CY							
0.0003488	2734.	7838319.	5.7000784	0.0019879	-0.001761	4.9780414	11.4419693
52.0000000 CY							
0.0003588	2793.	7786701.	5.6968833	0.0020438	-0.001813	4.9919840	11.7368180
52.0000000 CY							
0.0003688	2848.	7722884.	5.6959379	0.0021004	-0.001864	4.9990959	12.0538622
52.0000000 CY							
0.0003788	2897.	7649089.	5.6951640	0.0021570	-0.001915	4.9998116	12.3722458
52.0000000 CY							
0.0003888	2941.	7566038.	5.6937699	0.0022135	-0.001966	4.9999727	12.6831920
52.0000000 CY							
0.0003988	2980.	7474587.	5.6912027	0.0022694	-0.002017	4.9988167	12.9797638
52.0000000 CY							
0.0004088	3015.	7376108.	5.6872434	0.0023247	-0.002069	4.9992443	13.2583423
52.0000000 CY							
0.0004188	3046.	7273465.	5.6824313	0.0023795	-0.002122	4.9994560	13.5242683
52.0000000 CY							
0.0004288	3074.	7168722.	5.6771820	0.0024341	-0.002175	4.9995274	13.7819681
52.0000000 CY							
0.0004388	3099.	7063115.	5.6716880	0.0024885	-0.002228	4.9994866	14.0335088
52.0000000 CY							
0.0004488	3122.	6957522.	5.6660570	0.0025426	-0.002281	4.9993220	14.2800780
52.0000000 CY							
0.0004588	3143.	6852172.	5.6606039	0.0025968	-0.002335	4.9989931	14.5257479
52.0000000 CY							
0.0004688	3163.	6747890.	5.6552088	0.0026509	-0.002388	4.9984167	14.7690461
52.0000000 CY							
0.0004788	3181.	6645143.	5.6498506	0.0027049	-0.002442	4.9981833	15.0097311
52.0000000 CY							
0.0004888	3198.	6543655.	5.6445039	0.0027588	-0.002495	4.9999461	15.2474673
52.0000000 CY							
0.0004988	3214.	6443539.	5.6392991	0.0028126	-0.002549	4.9995446	15.4841510
52.0000000 CY							
0.0005088	3228.	6345666.	5.6341532	0.0028664	-0.002603	4.9985789	15.7186927
52.0000000 CY							
0.0005188	3242.	6249647.	5.6294076	0.0029203	-0.002656	4.9987854	15.9562691
52.0000000 CY							
0.0005288	3255.	6155208.	5.6244657	0.0029739	-0.002710	4.9997119	16.1880759
52.0000000 CY							
0.0005388	3266.	6063055.	5.6198259	0.0030277	-0.002764	4.9984741	16.4217489
52.0000000 CY							
0.0005488	3278.	5972848.	5.6154304	0.0030815	-0.002818	4.9999993	16.6566118
52.0000000 CY							
0.0006088	3332.	5472822.	5.5915435	0.0034039	-0.003140	4.9975591	18.0561385
52.0000000 CY							
0.0006688	3369.	5038457.	5.5725089	0.0037266	-0.003462	4.9999285	19.4666455
52.0000000 CY							
0.0007288	3397.	4661352.	5.5575947	0.0040501	-0.003784	4.9964107	20.8979977
52.0000000 CY							

Summary of Results for Nominal Moment Capacity for Section 1

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Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	122.470	3279.638	0.00300000	-0.00298539
2	169.870	3260.339	0.00300000	-0.00273619

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	122.470000	3280.	79.605500	2132.	7953942.
2	0.65	169.870000	3260.	110.415500	2119.	8007252.
1	0.75	122.470000	3280.	91.852500	2460.	7903362.
2	0.75	169.870000	3260.	127.402500	2445.	7946299.
1	0.90	122.470000	3280.	110.223000	2952.	7554020.
2	0.90	169.870000	3260.	152.883000	2934.	7579174.

Pile Section No. 2:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	7.000000 ft
Shaft Diameter	=	9.560000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.655000 in
Number of Reinforcing Bars	=	1 bar
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	71.780366 sq. in.
Total Area of Reinforcing Steel	=	2.250000 sq. in.
Area Ratio of Steel Reinforcement	=	3.13 percent
Edge-to-Edge Bar Spacing	=	-1.69300 in
Maximum Concrete Aggregate Size	=	0.375000 in
Ratio of Bar Spacing to Aggregate Size	=	-4.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = $0.85 F_c A_c + F_y A_s$	=	430.504 kips
Tensile Load for Cracking of Concrete	=	-39.723 kips
Nominal Axial Tensile Capacity	=	-135.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar	Bar Diam.	Bar Area	X	Y
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Number	inches	sq. in.	inches	inches
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1	1.693000	2.250000	0.00000	0.00000

NOTE: The positions of the above rebars were computed by LPILE

Concrete Properties:

Compressive Strength of Concrete	=	5000. psi
Modulus of Elasticity of Concrete	=	4030509. psi
Modulus of Rupture of Concrete	=	-530.33009 psi
Compression Strain at Peak Stress	=	0.002109
Tensile Strain at Fracture of Concrete	=	-0.0001150
Maximum Coarse Aggregate Size	=	0.375000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
-----	-----
1	122.470
2	169.870

Definitions of Run Messages and Notes:

- C = concrete in section has cracked in tension.
- Y = stress in reinforcing steel has reached yield stress.
- T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
- Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 122.470 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
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0.00000125	2.0646213	1651697.	270.2963391	0.0003379	0.0003259	1.4735305	9.6544240	
0.00000250	4.1252913	1650117.	137.5406691	0.0003439	0.0003200	1.4970718	9.6840620	
0.00000375	6.1859325	1649582.	93.2898979	0.0003498	0.0003140	1.5205509	9.7138216	
0.00000500	8.2465303	1649306.	71.1653513	0.0003558	0.0003080	1.5439675	9.7437029	
0.00000625	10.3070704	1649131.	57.8912947	0.0003618	0.0003021	1.5673216	9.7737059	
0.00000750	12.3675381	1649005.	49.0424830	0.0003678	0.0002961	1.5906130	9.8038305	
0.00000875	14.4279190	1648905.	42.7223827	0.0003738	0.0002902	1.6138414	9.8340768	
0.00001000	16.4881987	1648820.	37.9827270	0.0003798	0.0002842	1.6370068	9.8644448	
0.00001125	18.5483626	1648743.	34.2967012	0.0003858	0.0002783	1.6601089	9.8949345	
0.00001250	20.6083961	1648672.	31.3482162	0.0003919	0.0002724	1.6831476	9.9255459	
0.00001375	22.6682849	1648603.	28.9361246	0.0003979	0.0002664	1.7061227	9.9562789	
0.00001500	24.7280145	1648534.	26.9263280	0.0004039	0.0002605	1.7290340	9.9871337	
0.00001625	26.7875702	1648466.	25.2259892	0.0004099	0.0002546	1.7518814	10.0181102	
0.00001750	28.8469377	1648396.	23.7687958	0.0004160	0.0002487	1.7746648	10.0492084	
0.00001875	30.9061024	1648325.	22.5061187	0.0004220	0.0002427	1.7973838	10.0804283	
0.00002000	32.9650498	1648252.	21.4014861	0.0004280	0.0002368	1.8200385	10.1117700	
0.00002125	35.0237654	1648177.	20.4270079	0.0004341	0.0002309	1.8426286	10.1432334	
0.00002250	37.0822347	1648099.	19.5609916	0.0004401	0.0002250	1.8651539	10.1748186	

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0.00002375	39.1404431	1648019.	18.7863118	0.0004462	0.0002191	1.8876142	10.2065255
0.00002500	41.1983763	1647935.	18.0892679	0.0004522	0.0002132	1.9100095	10.2383543
0.00002625	43.2560196	1647848.	17.4587692	0.0004583	0.0002073	1.9323395	10.2703049
0.00002750	45.3133585	1647758.	16.8857412	0.0004644	0.0002015	1.9546041	10.3023772
0.00002875	47.3703785	1647665.	16.3626879	0.0004704	0.0001956	1.9768031	10.3345714
0.00003000	49.4270652	1647569.	15.8833625	0.0004765	0.0001897	1.9989363	10.3668874
0.00003125	51.4834038	1647469.	15.4425175	0.0004826	0.0001838	2.0210036	10.3993253
0.00003250	53.5393800	1647366.	15.0357130	0.0004887	0.0001780	2.0430047	10.4318851
0.00003375	55.5949792	1647259.	14.6591667	0.0004947	0.0001721	2.0649396	10.4645668
0.00003500	57.6501868	1647148.	14.3096367	0.0005008	0.0001662	2.0868081	10.4973704
0.00003625	59.7049884	1647034.	13.9843282	0.0005069	0.0001604	2.1086099	10.5302959
0.00003750	61.7593692	1646917.	13.6808191	0.0005130	0.0001545	2.1303450	10.5633434
0.00003875	63.8133149	1646795.	13.3969998	0.0005191	0.0001487	2.1520131	10.5965129
0.00004000	65.8668109	1646670.	13.1310243	0.0005252	0.0001428	2.1736140	10.6298043
0.00004125	67.9198425	1646542.	12.8812706	0.0005314	0.0001370	2.1951478	10.6632178
0.00004250	69.9723952	1646409.	12.6463072	0.0005375	0.0001312	2.2166140	10.6967533
0.00004375	72.0244545	1646273.	12.4248666	0.0005436	0.0001253	2.2380126	10.7304109
0.00004500	74.0760058	1646133.	12.2158218	0.0005497	0.0001195	2.2593434	10.7641906
0.00004625	76.1270345	1645990.	12.0181677	0.0005558	0.0001137	2.2806063	10.7980923
0.00004750	78.1775260	1645843.	11.8310052	0.0005620	0.0001079	2.3018010	10.8321163
0.00004875	80.2274657	1645692.	11.6535271	0.0005681	0.0001021	2.3229275	10.8662624
0.00005125	84.3256315	1645378.	11.3247901	0.0005804	0.00009045	2.3649747	10.9349212
0.00005375	88.4214150	1645050.	11.0269470	0.0005927	0.00007885	2.4067468	11.0040690
0.00005625	92.5146994	1644706.	10.7558787	0.0006050	0.00006727	2.4482422	11.0737060
0.00005875	96.6053675	1644347.	10.5081673	0.0006174	0.00005570	2.4894597	11.1438325
0.00006125	100.6933024	1643972.	10.2809531	0.0006297	0.00004416	2.5303978	11.2144488
0.00006375	104.7783867	1643583.	10.0718246	0.0006421	0.00003263	2.5710553	11.2855551
0.00006625	108.8605032	1643177.	9.8787345	0.0006545	0.00002112	2.6114307	11.3571517
0.00006875	112.9395344	1642757.	9.6999335	0.0006669	0.00000962	2.6515227	11.4292389
0.00007125	117.0153628	1642321.	9.5339175	0.0006793	-0.00000186	2.6913299	11.5018169
0.00007375	121.0877353	1641868.	9.3793853	0.0006917	-0.00001332	2.7308507	11.5748837
0.00007625	125.1558484	1641388.	9.2352015	0.0007042	-0.00002477	2.7700822	11.6484263
0.00007875	129.2186253	1640871.	9.1003725	0.0007167	-0.00003620	2.8090212	11.7224262
0.00008125	133.2749112	1640307.	8.9740259	0.0007291	-0.00004761	2.8476640	11.7968624
0.00008375	137.3236155	1639685.	8.8553935	0.0007416	-0.00005901	2.8860071	11.8717145
0.00008625	141.3637028	1638999.	8.7437966	0.0007542	-0.00007040	2.9240474	11.9469623
0.00008875	145.3942063	1638245.	8.6386332	0.0007667	-0.00008177	2.9617816	12.0225866
0.00009125	149.4142507	1637416.	8.5393676	0.0007792	-0.00009313	2.9992068	12.0985695
0.00009375	153.4230424	1636512.	8.4455219	0.0007918	-0.000104	3.0363202	12.1748943
0.00009625	153.4230424	1594006.	8.3189146	0.0008007	-0.000119	3.0624079	12.1461654 C
0.00009875	155.4253882	1573928.	8.2274749	0.0008125	-0.000132	3.0966383	12.1997898 C
0.0001013	158.2911935	1563370.	8.1399099	0.0008242	-0.000144	3.1303755	12.2515325 C
0.0001038	161.0710873	1552492.	8.0559662	0.0008358	-0.000156	3.1636325	12.3014739 C
0.0001063	163.7708270	1541372.	7.9754204	0.0008474	-0.000168	3.1964239	12.3497131 C
0.0001088	166.3834048	1529962.	7.8979549	0.0008589	-0.000181	3.2287288	12.3959878 C
0.0001113	168.9150825	1518338.	7.8233941	0.0008704	-0.000193	3.2605622	12.4404013 C
0.0001138	171.3804113	1506641.	7.7516599	0.0008818	-0.000206	3.2919648	12.4833275 C
0.0001163	173.7858218	1494932.	7.6826171	0.0008931	-0.000218	3.3229556	12.5249261 C
0.0001188	176.1173712	1483094.	7.6159565	0.0009044	-0.000231	3.3534931	12.5647167 C
0.0001213	178.3808662	1471182.	7.5515617	0.0009156	-0.000244	3.3835921	12.6028090 C
0.0001238	180.5994404	1459389.	7.4894958	0.0009268	-0.000256	3.4133232	12.6399215 C
0.0001263	182.7517330	1447538.	7.4294175	0.0009380	-0.000269	3.4426212	12.6753119 C
0.0001288	184.8477324	1435711.	7.3712830	0.0009491	-0.000282	3.4715147	12.7092487 C
0.0001313	186.9114618	1424087.	7.3151981	0.0009601	-0.000295	3.5000814	12.7425569 C
0.0001338	188.8958842	1412306.	7.2606027	0.0009711	-0.000308	3.5281696	12.7735080 C
0.0001363	190.8592822	1400802.	7.2079379	0.0009821	-0.000320	3.5559673	12.8041756 C
0.0001388	192.7573748	1389242.	7.1566876	0.0009930	-0.000333	3.5833306	12.8328962 C
0.0001413	194.6289357	1377904.	7.1071207	0.0010039	-0.000346	3.6103858	12.8610789 C
0.0001438	196.4457422	1366579.	7.0588859	0.0010147	-0.000360	3.6370409	12.8876313 C
0.0001463	198.2364928	1355463.	7.0121685	0.0010255	-0.000373	3.6633904	12.9136215 C
0.0001488	199.9745921	1344367.	6.9666424	0.0010363	-0.000386	3.6893462	12.9379809 C
0.0001588	206.6077144	1301466.	6.7970015	0.0010790	-0.000439	3.7899293	13.0267762 C
0.0001688	212.7619519	1260812.	6.6447263	0.0011213	-0.000492	3.8854626	13.1021649 C
0.0001788	218.4506427	1222101.	6.5067170	0.0011631	-0.000546	3.9760052	13.1631846 C
0.0001888	223.7911670	1185649.	6.3815195	0.0012045	-0.000600	4.0620104	13.2142871 C
0.0001988	228.8132335	1151262.	6.2673022	0.0012456	-0.000654	4.1436126	13.2560618 C
0.0002088	233.5385171	1118747.	6.1625272	0.0012864	-0.000709	4.2209156	13.2887516 C
0.0002188	238.0062238	1088028.	6.0661253	0.0013270	-0.000764	4.2940927	13.3137890 C
0.0002288	242.2477982	1059007.	5.9771851	0.0013673	-0.000820	4.3632874	13.3324128 C

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0.0002388	246.2708906	1031501.	5.8947398	0.0014074	-0.000875	4.4285479	13.3444198	C
0.0002488	250.1081486	1005460.	5.8182334	0.0014473	-0.000931	4.4900209	13.3514502	C
0.0002588	253.7826609	980803.	5.7471439	0.0014871	-0.000987	4.5478135	13.3547540	C
0.0002688	257.3160047	957455.	5.6810466	0.0015268	-0.001042	4.6020244	13.3557336	C
0.0002788	260.6756559	935159.	5.6190169	0.0015663	-0.001099	4.6525399	13.3512590	C
0.0002888	263.9138041	913987.	5.5611063	0.0016058	-0.001155	4.6995687	13.3452992	C
0.0002988	267.0414640	893863.	5.5070115	0.0016452	-0.001211	4.7431597	13.3388096	C
0.0003088	270.0322355	874598.	5.4560362	0.0016846	-0.001267	4.7832185	13.3288769	C
0.0003188	272.9439306	856295.	5.4084982	0.0017240	-0.001323	4.8199515	13.3211520	C
0.0003288	275.7258041	838710.	5.3635049	0.0017633	-0.001380	4.8531842	13.3101161	C
0.0003388	278.4338180	821945.	5.3214420	0.0018026	-0.001436	4.8830966	13.3017708	C
0.0003488	281.0375520	805842.	5.2817010	0.0018420	-0.001492	4.9095852	13.2925127	C
0.0003588	283.5524149	790390.	5.2442632	0.0018814	-0.001548	4.9326927	13.2841662	C
0.0003688	286.0029231	775601.	5.2092259	0.0019209	-0.001604	4.9524595	13.2797765	C
0.0003788	288.3337126	761277.	5.1757388	0.0019603	-0.001661	4.9687560	13.2720813	C
0.0003888	290.6013285	747528.	5.1443531	0.0019999	-0.001717	4.9816870	13.2686691	C
0.0003988	292.8045695	734306.	5.1149166	0.0020396	-0.001772	4.9912143	13.2695938	C
0.0004088	294.8958572	721458.	5.0866889	0.0020792	-0.001828	4.9972710	13.2677695	C
0.0004188	296.9215719	709066.	5.0601700	0.0021189	-0.001884	4.9998879	13.2703253	C
0.0004288	298.8752559	697085.	5.0352743	0.0021589	-0.001940	4.9998507	13.2776825	C
0.0004388	300.7398873	685447.	5.0117520	0.0021989	-0.001996	4.9997514	13.2880745	C
0.0004488	302.5010285	674097.	4.9893266	0.0022390	-0.002051	4.9995455	13.2990992	C
0.0004588	304.1852949	663074.	4.9682721	0.0022792	-0.002106	4.9991759	13.3153533	C
0.0004688	305.7943755	652361.	4.9484977	0.0023196	-0.002162	4.9985611	13.3367983	C
0.0004788	307.3304175	641943.	4.9299185	0.0023602	-0.002217	4.9999998	13.3633677	C
0.0004888	308.7725575	631760.	4.9122188	0.0024008	-0.002272	4.9998441	13.3916268	C
0.0004988	310.1375215	621830.	4.8954268	0.0024416	-0.002326	4.9993016	13.4227489	C
0.0005088	311.4385660	612164.	4.8796246	0.0024825	-0.002381	4.9982177	13.4587357	C
0.0005188	312.6742324	602746.	4.8647635	0.0025236	-0.002436	4.9999472	13.4997143	C
0.0005288	313.8444070	593559.	4.8507945	0.0025649	-0.002490	4.9993379	13.5457524	C
0.0005388	314.9592857	584611.	4.8376310	0.0026063	-0.002544	4.9978787	13.5962729	C
0.0005488	316.0100529	575873.	4.8251869	0.0026478	-0.002598	4.9998400	13.6506083	C
0.0006088	321.1619491	527576.	4.7630848	0.0028995	-0.002920	4.9978001	-14.644052	C
0.0006688	324.7179028	485559.	4.7194168	0.0031561	-0.003237	4.9999335	-16.934294	C
0.0007288	326.9846192	448692.	4.6885689	0.0034168	-0.003550	4.9971152	-19.105566	C
0.0007888	328.2309796	416141.	4.6676423	0.0036816	-0.003859	4.9973546	-21.157250	C
0.0008488	328.2309796	386723.	4.6693206	0.0039631	-0.004151	4.9968859	-22.725365	C

Axial Thrust Force = 169.870 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	1.9019181	1521534.	384.5486785	0.0004807	0.0004687	2.0193240	13.7960714	
0.00000250	3.7981532	1519261.	194.6670126	0.0004867	0.0004628	2.0409654	13.8257219	
0.00000375	5.6943574	1518495.	131.3743206	0.0004927	0.0004568	2.0625443	13.8555026	
0.00000500	7.5905153	1518103.	99.7288721	0.0004986	0.0004508	2.0840605	13.8854135	
0.00000625	9.4866114	1517858.	80.7423210	0.0005046	0.0004449	2.1055138	13.9154544	
0.00000750	11.3826301	1517684.	68.0852186	0.0005106	0.0004389	2.1269040	13.9456256	
0.00000875	13.2785560	1517549.	59.0449440	0.0005166	0.0004330	2.1482310	13.9759268	
0.00001000	15.1743735	1517437.	52.2651869	0.0005227	0.0004271	2.1694945	14.0063582	
0.00001125	17.0700672	1517339.	46.9924415	0.0005287	0.0004211	2.1906944	14.0369198	
0.00001250	18.9656216	1517250.	42.7746042	0.0005347	0.0004152	2.2118305	14.0676115	
0.00001375	20.8610211	1517165.	39.3239728	0.0005407	0.0004093	2.2329026	14.0984335	
0.00001500	22.7562502	1517083.	36.4487460	0.0005467	0.0004033	2.2539106	14.1293856	
0.00001625	24.6512934	1517003.	34.0161380	0.0005528	0.0003974	2.2748542	14.1604678	
0.00001750	26.5461353	1516922.	31.9313020	0.0005588	0.0003915	2.2957333	14.1916803	
0.00001875	28.4407602	1516841.	30.1246836	0.0005648	0.0003856	2.3165477	14.2230230	
0.00002000	30.3351527	1516758.	28.5441171	0.0005709	0.0003797	2.3372973	14.2544960	
0.00002125	32.2292973	1516673.	27.1497109	0.0005769	0.0003738	2.3579818	14.2860991	
0.00002250	34.1231784	1516586.	25.9104383	0.0005830	0.0003679	2.3786010	14.3178326	
0.00002375	36.0167806	1516496.	24.8018046	0.0005890	0.0003620	2.3991549	14.3496963	
0.00002500	37.9100882	1516404.	23.8042140	0.0005951	0.0003561	2.4196431	14.3816902	
0.00002625	39.8030857	1516308.	22.9018032	0.0006012	0.0003502	2.4400656	14.4138145	
0.00002750	41.6957577	1516209.	22.0815931	0.0006072	0.0003443	2.4604221	14.4460691	
0.00002875	43.5880885	1516107.	21.3328620	0.0006133	0.0003385	2.4807125	14.4784540	
0.00003000	45.4800627	1516002.	20.6466750	0.0006194	0.0003326	2.5009366	14.5109693	

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0.00003125	47.3716646	1515893.	20.0155268	0.0006255	0.0003267	2.5210942	14.5436150
0.00003250	49.2628788	1515781.	19.4330668	0.0006316	0.0003209	2.5411851	14.5763911
0.00003375	51.1536896	1515665.	18.8938853	0.0006377	0.0003150	2.5612092	14.6092975
0.00003500	53.0440816	1515545.	18.3933452	0.0006438	0.0003092	2.5811662	14.6423345
0.00003625	54.9340392	1515422.	17.9274493	0.0006499	0.0003033	2.6010560	14.6755019
0.00003750	56.8235467	1515295.	17.4927330	0.0006560	0.0002975	2.6208784	14.7087998
0.00003875	58.7125886	1515164.	17.0861791	0.0006621	0.0002916	2.6406332	14.7422282
0.00004000	60.6011494	1515029.	16.7051474	0.0006682	0.0002858	2.6603203	14.7757871
0.00004125	62.4892134	1514890.	16.3473177	0.0006743	0.0002800	2.6799394	14.8094766
0.00004250	64.3767651	1514747.	16.0106427	0.0006805	0.0002742	2.6994905	14.8432967
0.00004375	66.2637889	1514601.	15.6933092	0.0006866	0.0002683	2.7189732	14.8772475
0.00004500	68.1502691	1514450.	15.3937055	0.0006927	0.0002625	2.7383874	14.9113288
0.00004625	70.0361902	1514296.	15.1103941	0.0006989	0.0002567	2.7577330	14.9455409
0.00004750	71.9215365	1514138.	14.8420886	0.0007050	0.0002509	2.7770097	14.9798837
0.00004875	73.8062924	1513975.	14.5876349	0.0007111	0.0002451	2.7962174	15.0143573
0.00005125	77.5739707	1513638.	14.1162287	0.0007235	0.0002335	2.8344250	15.0836967
0.00005375	81.3390999	1513286.	13.6890099	0.0007358	0.0002219	2.8723544	15.1535596
0.00005625	85.1015548	1512917.	13.3000872	0.0007481	0.0002104	2.9100040	15.2239462
0.00005875	88.8612101	1512531.	12.9445719	0.0007605	0.0001988	2.9473723	15.2948567
0.00006125	92.6179403	1512130.	12.6183734	0.0007729	0.0001873	2.9844581	15.3662916
0.00006375	96.3716200	1511712.	12.3180428	0.0007853	0.0001758	3.0212597	15.4382511
0.00006625	100.1221232	1511277.	12.0406520	0.0007977	0.0001643	3.0577757	15.5107357
0.00006875	103.8693243	1510827.	11.7836986	0.0008101	0.0001529	3.0940047	15.5837456
0.00007125	107.6130973	1510359.	11.5450314	0.0008226	0.0001414	3.1299452	15.6572812
0.00007375	111.3533159	1509875.	11.3227911	0.0008351	0.0001300	3.1655957	15.7313429
0.00007625	115.0898538	1509375.	11.1153620	0.0008475	0.0001186	3.2009547	15.8059312
0.00007875	118.8225847	1508858.	10.9213337	0.0008601	0.0001072	3.2360209	15.8810464
0.00008125	122.5513818	1508325.	10.7394695	0.0008726	0.00009583	3.2707926	15.9566889
0.00008375	126.2761184	1507775.	10.5686801	0.0008851	0.00008448	3.3052684	16.0328593
0.00008625	129.9966674	1507208.	10.4008028	0.0008977	0.00007314	3.3394468	16.1095580
0.00008875	133.7129017	1506624.	10.2565832	0.0009103	0.00006182	3.3733264	16.1867854
0.00009125	137.4246938	1506024.	10.1136605	0.0009229	0.00005052	3.4069057	16.2645421
0.00009375	141.1319162	1505407.	9.9785552	0.0009355	0.00003924	3.4401831	16.3428285
0.00009625	144.8344411	1504773.	9.8506584	0.0009481	0.00002798	3.4731572	16.4216453
0.00009875	148.5321405	1504123.	9.7294227	0.0009608	0.00001673	3.5058265	16.5009928
0.0001013	152.2248862	1503456.	9.6143549	0.0009735	0.00000550	3.5381895	16.5808717
0.0001038	155.9125491	1502772.	9.5050094	0.0009861	-0.00000571	3.5702446	16.6612825
0.0001063	159.5948278	1502069.	9.4009811	0.0009989	-0.00001690	3.6019901	16.7422222
0.0001088	163.2711383	1501344.	9.3019007	0.0010116	-0.00002807	3.6334237	16.8236819
0.0001113	166.9407694	1500591.	9.2074308	0.0010243	-0.00003922	3.6645428	16.9056496
0.0001138	170.6029701	1499806.	9.1172634	0.0010371	-0.00005036	3.6953448	16.9881121
0.0001163	174.2569859	1498985.	9.0311168	0.0010499	-0.00006148	3.7258271	17.0710555
0.0001188	177.9020825	1498123.	8.9487331	0.0010627	-0.00007259	3.7559872	17.1544663
0.0001213	181.5375677	1497217.	8.8698759	0.0010755	-0.00008368	3.7858227	17.2383312
0.0001238	185.1627752	1496265.	8.7943278	0.0010883	-0.00009475	3.8153311	17.3226374
0.0001263	188.7770669	1495264.	8.7218887	0.0011011	-0.000106	3.8445103	17.4073722
0.0001288	189.1478403	1469109.	8.6326426	0.0011115	-0.000119	3.8676324	17.4188498 C
0.0001313	192.0665589	1463364.	8.5620125	0.0011238	-0.000131	3.8949772	17.4882430 C
0.0001338	194.8984194	1457184.	8.4935880	0.0011360	-0.000143	3.9218598	17.5559508 C
0.0001363	197.6723090	1450806.	8.4274330	0.0011482	-0.000154	3.9483399	17.6227059 C
0.0001388	200.3941854	1444282.	8.3634623	0.0011604	-0.000166	3.9744311	17.6886561 C
0.0001413	203.0242125	1437340.	8.3012738	0.0011726	-0.000178	4.0000502	17.7526308 C
0.0001438	205.6068926	1430309.	8.2410676	0.0011847	-0.000190	4.0252908	17.8158523 C
0.0001463	208.1374605	1423162.	8.1827080	0.0011967	-0.000201	4.0501448	17.8781753 C
0.0001488	210.5891228	1415725.	8.1259031	0.0012087	-0.000213	4.0745543	17.9387433 C
0.0001588	219.9028319	1385215.	7.9145792	0.0012564	-0.000261	4.1684023	18.1718233 C
0.0001688	228.4246290	1353627.	7.7250031	0.0013036	-0.000310	4.2562169	18.3887688 C
0.0001788	236.2527320	1321694.	7.5538232	0.0013502	-0.000359	4.3382650	18.5911220 C
0.0001888	243.4896953	1290012.	7.3985249	0.0013965	-0.000408	4.4148285	18.7811202 C
0.0001988	250.1614129	1258674.	7.2566383	0.0014423	-0.000458	4.4860171	18.9583477 C
0.0002088	256.3868993	1228201.	7.1268548	0.0014877	-0.000508	4.5521484	19.1265460 C
0.0002188	262.1544079	1198420.	7.0072584	0.0015328	-0.000558	4.6132437	19.2841014 C
0.0002288	267.5410240	1169578.	6.8969001	0.0015777	-0.000609	4.6695206	19.4335682 C
0.0002388	272.5847878	1141716.	6.7947709	0.0016223	-0.000660	4.7211039	19.5760100 C
0.0002488	277.3136768	1114829.	6.6999785	0.0016666	-0.000711	4.7680905	19.7121380 C
0.0002588	281.7551034	1088909.	6.6117846	0.0017108	-0.000763	4.8105720	19.8428007 C
0.0002688	285.9356652	1063947.	6.5295777	0.0017548	-0.000814	4.8486315	19.9689722 C
0.0002788	289.8809609	1039932.	6.4528513	0.0017987	-0.000866	4.8823427	20.0917678 C
0.0002888	293.5599069	1016658.	6.3807178	0.0018424	-0.000918	4.9116816	20.2085205 C

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0.0002988	297.0395962	994275.	6.3131767	0.0018861	-0.000970	4.9367824	20.3232235 C
0.0003088	300.3432160	972772.	6.2499489	0.0019297	-0.001022	4.9576882	20.4373730 C
0.0003188	303.4332443	951947.	6.1902879	0.0019732	-0.001074	4.9743677	20.5478208 C
0.0003288	306.3515415	931868.	6.1341624	0.0020166	-0.001126	4.9868814	20.6573719 C
0.0003388	309.1187548	912528.	6.0814326	0.0020601	-0.001178	4.9952470	20.7677285 C
0.0003488	311.6945823	893748.	6.0314215	0.0021035	-0.001231	4.9994496	20.8749975 C
0.0003588	314.1455587	875667.	5.9845337	0.0021470	-0.001283	4.9997979	20.9857556 C
0.0003688	316.3998200	858033.	5.9399740	0.0021904	-0.001335	4.9999498	21.0942147 C
0.0003788	318.5193112	840975.	5.8981472	0.0022339	-0.001387	4.9999967	21.2068456 C
0.0003888	320.4754415	824374.	5.8585556	0.0022775	-0.001439	4.9993976	21.3204171 C
0.0003988	322.2789761	808223.	5.8210760	0.0023212	-0.001491	4.9988574	21.4354474 C
0.0004088	323.9802134	792612.	5.7859665	0.0023650	-0.001543	4.9990679	21.5568342 C
0.0004188	325.5059583	777328.	5.7522506	0.0024088	-0.001594	4.9999998	21.6747807 C
0.0004288	326.9319056	762523.	5.7205531	0.0024527	-0.001646	4.9999759	21.7982690 C
0.0004388	328.2690715	748192.	5.6907705	0.0024968	-0.001698	4.9998746	21.9277301 C
0.0004488	329.4595129	734172.	5.6620671	0.0025409	-0.001749	4.9996145	22.0539755 C
0.0004588	330.5665543	720581.	5.6349681	0.0025850	-0.001801	4.9991045	22.1849078 C
0.0004688	331.6009225	707415.	5.6094208	0.0026294	-0.001852	4.9982321	22.3212098 C
0.0004788	332.5444734	694610.	5.5851390	0.0026739	-0.001903	4.9999428	22.4602857 C
0.0004888	333.3821007	682112.	5.5617881	0.0027183	-0.001954	4.9994865	22.5984601 C
0.0004988	334.1605370	669996.	5.5397069	0.0027629	-0.002005	4.9984314	22.7414560 C
0.0005088	334.8785377	658238.	5.5188279	0.0028077	-0.002056	4.9999534	22.8893812 C
0.0005188	335.5346270	646814.	5.4990916	0.0028527	-0.002107	4.9993005	23.0423867 C
0.0005288	336.1078752	635665.	5.4799178	0.0028975	-0.002157	4.9977426	23.1925711 C
0.0005388	336.6197825	624816.	5.4617173	0.0029425	-0.002208	4.9997035	23.3468409 C
0.0005488	337.0861734	614280.	5.4444441	0.0029876	-0.002258	4.9982606	23.5053125 C
0.0006088	338.8877090	556694.	5.3563539	0.0032607	-0.002559	4.9980859	24.5202461 C
0.0006688	339.3219153	507397.	5.2894484	0.0035373	-0.002856	4.9998858	25.6394778 C
0.0007288	339.3219153	465622.	5.2377880	0.0038170	-0.003150	4.9994479	26.8480642 C

Summary of Results for Nominal Moment Capacity for Section 2

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	122.470	322.554	0.00300000	-0.00304426
2	169.870	337.168	0.00300000	-0.00227202

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	122.470000	322.554385	79.605500	209.660350	1281300.
2	0.65	169.870000	337.167733	110.415500	219.159027	1387651.
1	0.75	122.470000	322.554385	91.852500	241.915789	1061278.
2	0.75	169.870000	337.167733	127.402500	252.875800	1245387.
1	0.90	122.470000	322.554385	110.223000	290.298946	749361.

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2 0.90 169.870000 337.167733 152.883000 303.450960 951826.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	24865.
2	8.0000	8.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 21320.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 169870.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.3971	-1302450.	21320.	0.00	0.00	8.24E+09	0.00	0.00	0.00
0.1600	0.3968	-1261466.	21316.	-2.99E-04	0.00	8.24E+09	-4.339	20.9991	0.00
0.3200	0.3959	-1220402.	21303.	-5.88E-04	0.00	8.27E+09	-9.272	44.9664	0.00
0.4800	0.3945	-1179280.	21280.	-8.66E-04	0.00	8.29E+09	-14.632	71.2102	0.00
0.6400	0.3926	-1138123.	21246.	-0.00113	0.00	8.31E+09	-20.213	98.8556	0.00
0.8000	0.3901	-1096954.	21202.	-0.00139	0.00	8.33E+09	-25.868	127.3038	0.00
0.9600	0.3872	-1055799.	21147.	-0.00164	0.00	8.35E+09	-31.478	156.0729	0.00
1.1200	0.3839	-1014680.	21081.	-0.00188	0.00	8.38E+09	-36.938	184.7586	0.00
1.2800	0.3800	-973622.	21006.	-0.00210	0.00	8.40E+09	-42.044	212.4197	0.00
1.4400	0.3758	-932646.	20920.	-0.00232	0.00	8.43E+09	-47.064	240.4708	0.00
1.6000	0.3711	-891774.	20825.	-0.00253	0.00	8.45E+09	-51.900	268.5113	0.00
1.7600	0.3661	-851028.	20721.	-0.00273	0.00	8.48E+09	-56.201	294.7766	0.00
1.9200	0.3606	-810426.	20609.	-0.00291	0.00	8.52E+09	-60.240	320.7114	0.00
2.0800	0.3549	-769986.	20490.	-0.00309	0.00	8.55E+09	-63.733	344.8256	0.00
2.2400	0.3488	-729725.	20365.	-0.00326	0.00	8.58E+09	-66.503	366.1119	0.00
2.4000	0.3423	-689656.	20234.	-0.00342	0.00	8.62E+09	-70.068	392.9678	0.00
2.5600	0.3356	-649795.	20097.	-0.00357	0.00	8.66E+09	-73.034	417.7982	0.00
2.7200	0.3286	-610156.	19954.	-0.00371	0.00	8.70E+09	-75.794	442.8050	0.00
2.8800	0.3214	-570753.	19805.	-0.00384	0.00	8.74E+09	-79.889	477.2552	0.00
3.0400	0.3139	-531603.	19648.	-0.00396	0.00	8.78E+09	-83.576	511.1928	0.00
3.2000	0.3062	-492724.	19484.	-0.00407	0.00	8.83E+09	-86.792	544.2308	0.00
3.3600	0.2983	-454129.	19315.	-0.00417	0.00	8.90E+09	-89.472	575.9264	0.00
3.5200	0.2902	-415832.	19141.	-0.00427	0.00	8.91E+09	-91.551	605.7720	0.00
3.6800	0.2819	-377844.	18962.	-0.00435	0.00	8.91E+09	-95.105	647.7689	0.00
3.8400	0.2735	-340180.	18775.	-0.00443	0.00	8.91E+09	-99.790	700.6365	0.00
4.0000	0.2649	-302859.	18579.	-0.00450	0.00	8.91E+09	-104.279	755.8575	0.00

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4.1600	0.2562	-265902.	18375.	-0.00456	0.00	8.91E+09	-108.543	813.4798	0.00
4.3200	0.2474	-229326.	18162.	-0.00461	0.00	8.91E+09	-112.550	873.5538	0.00
4.4800	0.2385	-193149.	17943.	-0.00466	0.00	8.91E+09	-116.276	936.1717	0.00
4.6400	0.2295	-157387.	17715.	-0.00470	0.00	8.91E+09	-120.703	1010.	0.00
4.8000	0.2204	-122059.	17479.	-0.00473	0.00	8.91E+09	-124.946	1088.	0.00
4.9600	0.2113	-87183.	17236.	-0.00475	0.00	8.91E+09	-128.987	1172.	0.00
5.1200	0.2022	-52777.	16984.	-0.00476	0.00	8.91E+09	-132.811	1261.	0.00
5.2800	0.1930	-18856.	16726.	-0.00477	0.00	8.91E+09	-136.403	1357.	0.00
5.4400	0.1839	14563.	16461.	-0.00477	0.00	8.91E+09	-139.751	1459.	0.00
5.6000	0.1747	47467.	16189.	-0.00477	0.00	8.91E+09	-142.831	1570.	0.00
5.7600	0.1656	79840.	15913.	-0.00475	0.00	8.91E+09	-145.557	1688.	0.00
5.9200	0.1565	111671.	15631.	-0.00473	0.00	8.91E+09	-147.884	1815.	0.00
6.0800	0.1474	142949.	15345.	-0.00470	0.00	8.91E+09	-149.782	1951.	0.00
6.2400	0.1384	173665.	15056.	-0.00467	0.00	8.91E+09	-151.216	2098.	0.00
6.4000	0.1295	203811.	14765.	-0.00463	0.00	8.91E+09	-152.151	2256.	0.00
6.5600	0.1206	233382.	14472.	-0.00458	0.00	8.91E+09	-152.549	2428.	0.00
6.7200	0.1119	262374.	14180.	-0.00453	0.00	8.91E+09	-152.372	2615.	0.00
6.8800	0.1032	290786.	13888.	-0.00447	0.00	8.91E+09	-151.577	2819.	0.00
7.0400	0.09471	318619.	13598.	-0.00440	0.00	8.91E+09	-150.117	3043.	0.00
7.2000	0.08633	345876.	13312.	-0.00433	0.00	8.91E+09	-147.944	3290.	0.00
7.3600	0.07808	372563.	13031.	-0.00425	0.00	8.91E+09	-145.001	3566.	0.00
7.5200	0.06999	398689.	12756.	-0.00417	0.00	8.91E+09	-141.224	3874.	0.00
7.6800	0.06206	424267.	12490.	-0.00408	0.00	8.91E+09	-136.536	4224.	0.00
7.8400	0.05431	449312.	12233.	-0.00399	0.00	8.90E+09	-130.849	4626.	0.00
8.0000	0.04675	473843.	9542.	-0.00389	0.00	8.90E+09	-2672.	109729.	0.00
8.1600	0.03938	488492.	3114.	-0.00378	0.00	8.85E+09	-4025.	196243.	0.00
8.3200	0.03221	488268.	-4110.	-0.00368	0.00	8.85E+09	-3500.	208586.	0.00
8.4800	0.02525	475109.	-10273.	-0.00357	0.00	8.90E+09	-2920.	222035.	0.00
8.6400	0.01849	451151.	-15265.	-0.00347	0.00	8.90E+09	-2280.	236739.	0.00
8.8000	0.01191	418757.	-18959.	-0.00338	0.00	8.91E+09	-1569.	252881.	0.00
8.9600	0.00550	380552.	-21210.	-0.00329	0.00	8.91E+09	-776.106	270697.	0.00
9.1200	-7.43E-04	339459.	-21890.	-0.00254	0.00	4.59E+08	68.1076	176107.	0.00
9.2800	-0.00426	298154.	-21459.	-0.00154	0.00	9.86E+08	380.5255	171336.	0.00
9.4400	-0.00667	258063.	-20533.	-0.00105	0.00	1.22E+09	584.6387	168254.	0.00
9.6000	-0.00830	219994.	-19282.	-6.95E-04	0.00	1.38E+09	718.5952	166261.	0.00
9.7600	-0.00934	184474.	-17821.	-4.24E-04	0.00	1.50E+09	802.7994	165035.	0.00
9.9200	-0.00993	151837.	-16235.	-2.09E-04	0.00	1.50E+09	849.8405	164378.	0.00
10.0800	-0.01014	122270.	-14586.	-3.39E-05	0.00	1.51E+09	867.1146	164171.	0.00
10.2400	-0.01006	95848.	-12928.	1.05E-04	0.00	1.51E+09	860.6818	164319.	0.00
10.4000	-0.00974	72560.	-11299.	2.12E-04	0.00	1.51E+09	835.6114	164742.	0.00
10.5600	-0.00924	52321.	-9733.	2.91E-04	0.00	1.52E+09	796.2068	165373.	0.00
10.7200	-0.00862	34997.	-8252.	3.46E-04	0.00	1.52E+09	746.1546	166156.	0.00
10.8800	-0.00792	20408.	-6875.	3.81E-04	0.00	1.52E+09	688.6249	167043.	0.00
11.0400	-0.00716	8350.	-5612.	3.99E-04	0.00	1.52E+09	626.3384	167992.	0.00
11.2000	-0.00638	-1403.	-4472.	4.04E-04	0.00	1.52E+09	561.6132	168969.	0.00
11.3600	-0.00561	-9085.	-3456.	3.97E-04	0.00	1.52E+09	496.3970	169946.	0.00
11.5200	-0.00486	-14933.	-2565.	3.82E-04	0.00	1.52E+09	432.2984	170899.	0.00
11.6800	-0.00414	-19182.	-1794.	3.60E-04	0.00	1.52E+09	370.6105	171811.	0.00
11.8400	-0.00347	-22056.	-1138.	3.34E-04	0.00	1.52E+09	312.3355	172667.	0.00
12.0000	-0.00286	-23770.	-590.366	3.05E-04	0.00	1.52E+09	258.2105	173457.	0.00
12.1600	-0.00230	-24522.	-142.098	2.75E-04	0.00	1.52E+09	208.7353	174175.	0.00
12.3200	-0.00180	-24495.	215.9205	2.44E-04	0.00	1.52E+09	164.2007	174818.	0.00
12.4800	-0.00137	-23852.	493.2828	2.13E-04	0.00	1.52E+09	124.7184	175385.	0.00
12.6400	-9.85E-04	-22740.	699.6533	1.84E-04	0.00	1.52E+09	90.2508	175877.	0.00
12.8000	-6.60E-04	-21285.	844.5081	1.56E-04	0.00	1.52E+09	60.6395	176297.	0.00
12.9600	-3.87E-04	-19599.	936.9293	1.30E-04	0.00	1.52E+09	35.6326	176650.	0.00
13.1200	-1.62E-04	-17772.	985.4502	1.06E-04	0.00	1.52E+09	14.9099	176941.	0.00
13.2800	2.05E-05	-15884.	997.9454	8.49E-05	0.00	1.52E+09	-1.894	177123.	0.00
13.4400	1.64E-04	-13996.	981.5945	6.60E-05	0.00	1.52E+09	-15.138	176940.	0.00
13.6000	2.74E-04	-12157.	942.8404	4.95E-05	0.00	1.52E+09	-25.231	176801.	0.00
13.7600	3.54E-04	-10407.	887.3250	3.52E-05	0.00	1.52E+09	-32.598	176701.	0.00
13.9200	4.09E-04	-8773.	819.8985	2.31E-05	0.00	1.52E+09	-37.638	176633.	0.00
14.0800	4.43E-04	-7274.	744.6731	1.29E-05	0.00	1.52E+09	-40.722	176592.	0.00
14.2400	4.59E-04	-5922.	665.0828	4.57E-06	0.00	1.52E+09	-42.185	176574.	0.00
14.4000	4.60E-04	-4723.	583.9483	-2.16E-06	0.00	1.52E+09	-42.330	176574.	0.00
14.5600	4.50E-04	-3678.	503.5437	-7.47E-06	0.00	1.52E+09	-41.425	176588.	0.00
14.7200	4.32E-04	-2784.	425.6637	-1.16E-05	0.00	1.52E+09	-39.700	176613.	0.00
14.8800	4.06E-04	-2036.	351.6894	-1.46E-05	0.00	1.52E+09	-37.356	176646.	0.00
15.0400	3.76E-04	-1424.	282.6515	-1.68E-05	0.00	1.52E+09	-34.558	176685.	0.00

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15.2000	3.42E-04	-939.716	219.2911	-1.83E-05	0.00	1.52E+09	-31.442	176728.	0.00
15.3600	3.05E-04	-570.479	162.1160	-1.92E-05	0.00	1.52E+09	-28.115	176774.	0.00
15.5200	2.68E-04	-304.650	111.4522	-1.98E-05	0.00	1.52E+09	-24.660	176821.	0.00
15.6800	2.29E-04	-129.601	67.4902	-2.01E-05	0.00	1.52E+09	-21.134	176869.	0.00
15.8400	1.91E-04	-32.408	30.3267	-2.02E-05	0.00	1.52E+09	-17.578	176917.	0.00
16.0000	1.52E-04	0.00	0.00	-2.02E-05	0.00	1.52E+09	-14.012	88482.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

* WARNING: Some values of computed curvature exceeded the maximum curvature calculated or entered by the user
Depth = 9.1200 ft Computed Curv. = 7.39E-04 rad/in Maximum Curv. = 7.29E-04 rad/in

Output Summary for Load Case No. 1:

Pile-head deflection = 0.39705043 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -1302450. inch-lbs
Maximum shear force = -21890. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 9.12000000 feet below pile head
Number of iterations = 43
Number of zero deflection points = 2

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

Shear = 21320. lbs
Slope = 0.00000
Axial Load = 169870. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
16.00000	0.39705043	-1302450.	-21890.
15.20000	0.39669769	-1302162.	-21985.
14.40000	0.40513986	-1314978.	-21418.
13.60000	0.39410078	-1299297.	-22025.
12.80000	0.40502171	-1314412.	-21381.
12.00000	0.39712010	-1303180.	-21781.
11.20000	0.40603324	-1314026.	-22463.
10.40000	0.42193009	-1336048.	-26308.
9.60000	0.54852736	-1538785.	21320.
8.80000	0.63397051	-1713683.	21320.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 10370.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 122470.0 lbs

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(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1537	-574350.	10370.	0.00	0.00	8.57E+09	0.00	0.00	0.00
0.1600	0.1535	-554424.	10367.	-1.26E-04	0.00	8.57E+09	-3.147	39.3480	0.00
0.3200	0.1532	-534481.	10358.	-2.48E-04	0.00	8.62E+09	-6.659	83.4593	0.00
0.4800	0.1526	-514535.	10341.	-3.65E-04	0.00	8.64E+09	-10.413	131.0178	0.00
0.6400	0.1518	-494600.	10317.	-4.77E-04	0.00	8.67E+09	-14.337	181.3532	0.00
0.8000	0.1508	-474692.	10286.	-5.84E-04	0.00	8.70E+09	-18.281	232.8157	0.00
0.9600	0.1495	-454826.	10247.	-6.86E-04	0.00	8.72E+09	-22.168	284.6191	0.00
1.1200	0.1481	-435019.	10201.	-7.84E-04	0.00	8.75E+09	-25.936	336.1749	0.00
1.2800	0.1465	-415286.	10148.	-8.77E-04	0.00	8.78E+09	-29.421	385.5025	0.00
1.4400	0.1448	-395639.	10088.	-9.65E-04	0.00	8.95E+09	-32.799	435.0257	0.00
1.6000	0.1428	-376093.	10022.	-0.00105	0.00	8.95E+09	-35.997	483.9119	0.00
1.7600	0.1407	-356661.	9950.	-0.00113	0.00	8.95E+09	-38.765	528.8533	0.00
1.9200	0.1385	-337354.	9873.	-0.00120	0.00	8.95E+09	-41.400	573.9259	0.00
2.0800	0.1361	-318182.	9792.	-0.00127	0.00	8.95E+09	-43.645	615.5954	0.00
2.2400	0.1336	-299156.	9706.	-0.00134	0.00	8.95E+09	-45.343	651.5442	0.00
2.4000	0.1310	-280281.	9618.	-0.00140	0.00	8.95E+09	-47.141	690.9751	0.00
2.5600	0.1282	-261566.	9526.	-0.00146	0.00	8.95E+09	-48.389	724.4340	0.00
2.7200	0.1254	-243016.	9432.	-0.00151	0.00	8.95E+09	-49.327	755.2729	0.00
2.8800	0.1224	-224636.	9336.	-0.00156	0.00	8.95E+09	-50.952	798.9715	0.00
3.0400	0.1194	-206432.	9237.	-0.00161	0.00	8.95E+09	-52.127	838.2342	0.00
3.2000	0.1163	-188410.	9136.	-0.00165	0.00	8.95E+09	-52.804	871.9773	0.00
3.3600	0.1131	-170573.	9035.	-0.00169	0.00	8.95E+09	-52.939	899.0083	0.00
3.5200	0.1098	-152923.	8933.	-0.00172	0.00	8.95E+09	-52.492	918.0259	0.00
3.6800	0.1064	-135459.	8832.	-0.00175	0.00	8.95E+09	-53.601	966.8320	0.00
3.8400	0.1030	-118185.	8726.	-0.00178	0.00	8.95E+09	-55.893	1041.	0.00
4.0000	0.09960	-101112.	8617.	-0.00180	0.00	8.95E+09	-58.026	1119.	0.00
4.1600	0.09612	-84247.	8504.	-0.00182	0.00	8.95E+09	-59.979	1198.	0.00
4.3200	0.09260	-67599.	8387.	-0.00184	0.00	8.95E+09	-61.734	1280.	0.00
4.4800	0.08905	-51175.	8267.	-0.00185	0.00	8.95E+09	-63.278	1364.	0.00
4.6400	0.08548	-34982.	8143.	-0.00186	0.00	8.95E+09	-65.742	1477.	0.00
4.8000	0.08189	-19030.	8015.	-0.00187	0.00	8.95E+09	-68.089	1596.	0.00
4.9600	0.07830	-3327.	7882.	-0.00187	0.00	8.96E+09	-70.305	1724.	0.00
5.1200	0.07471	12116.	7745.	-0.00187	0.00	8.96E+09	-72.374	1860.	0.00
5.2800	0.07112	27292.	7604.	-0.00187	0.00	8.95E+09	-74.281	2005.	0.00
5.4400	0.06754	42193.	7460.	-0.00186	0.00	8.95E+09	-76.012	2161.	0.00
5.6000	0.06398	56812.	7312.	-0.00185	0.00	8.95E+09	-77.549	2327.	0.00
5.7600	0.06045	71141.	7162.	-0.00183	0.00	8.95E+09	-78.879	2506.	0.00
5.9200	0.05694	85177.	7010.	-0.00182	0.00	8.95E+09	-79.985	2697.	0.00
6.0800	0.05347	98913.	6855.	-0.00180	0.00	8.95E+09	-80.851	2903.	0.00
6.2400	0.05003	112346.	6699.	-0.00178	0.00	8.95E+09	-81.461	3126.	0.00
6.4000	0.04665	125473.	6543.	-0.00175	0.00	8.95E+09	-81.797	3367.	0.00
6.5600	0.04332	138293.	6386.	-0.00172	0.00	8.95E+09	-81.844	3628.	0.00
6.7200	0.04004	150803.	6229.	-0.00169	0.00	8.95E+09	-81.582	3912.	0.00
6.8800	0.03682	163006.	6073.	-0.00166	0.00	8.95E+09	-80.993	4223.	0.00
7.0400	0.03368	174901.	5918.	-0.00162	0.00	8.95E+09	-80.057	4564.	0.00
7.2000	0.03060	186493.	5766.	-0.00158	0.00	8.95E+09	-78.753	4941.	0.00
7.3600	0.02760	197785.	5616.	-0.00154	0.00	8.95E+09	-77.058	5360.	0.00
7.5200	0.02469	208782.	5470.	-0.00150	0.00	8.95E+09	-74.946	5829.	0.00
7.6800	0.02185	219494.	5329.	-0.00145	0.00	8.95E+09	-72.387	6359.	0.00
7.8400	0.01911	229927.	5193.	-0.00140	0.00	8.95E+09	-69.346	6966.	0.00
8.0000	0.01647	240093.	3843.	-0.00135	0.00	8.95E+09	-1337.	155864.	0.00
8.1600	0.01392	245318.	836.8124	-0.00130	0.00	8.95E+09	-1794.	247468.	0.00
8.3200	0.01147	243917.	-2342.	-0.00125	0.00	8.95E+09	-1518.	253942.	0.00
8.4800	0.00913	236910.	-4988.	-0.00120	0.00	8.95E+09	-1238.	260421.	0.00
8.6400	0.00688	225327.	-7095.	-0.00115	0.00	8.95E+09	-956.315	266892.	0.00
8.8000	0.00472	210206.	-8658.	-0.00110	0.00	8.95E+09	-672.555	273349.	0.00
8.9600	0.00265	192596.	-9675.	-0.00106	0.00	8.95E+09	-386.888	279790.	0.00
9.1200	6.65E-04	173550.	-10107.	-9.25E-04	0.00	1.50E+09	-62.477	180345.	0.00
9.2800	-8.97E-04	154222.	-10086.	-7.20E-04	0.00	1.59E+09	84.0990	180014.	0.00
9.4400	-0.00210	135159.	-9818.	-5.48E-04	0.00	1.64E+09	195.1219	178290.	0.00
9.6000	-0.00300	116779.	-9365.	-4.01E-04	0.00	1.64E+09	276.7780	177036.	0.00
9.7600	-0.00364	99386.	-8779.	-2.74E-04	0.00	1.64E+09	333.9950	176170.	0.00
9.9200	-0.00406	83198.	-8102.	-1.68E-04	0.00	1.65E+09	370.9622	175622.	0.00

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10.0800	-0.00428	68355.	-7370.	-7.95E-05	0.00	1.65E+09	391.2753	175333.	0.00
10.2400	-0.00436	54935.	-6612.	-7.60E-06	0.00	1.65E+09	398.0415	175254.	0.00
10.4000	-0.00431	42967.	-5852.	4.94E-05	0.00	1.65E+09	393.9568	175340.	0.00
10.5600	-0.00417	32440.	-5108.	9.34E-05	0.00	1.65E+09	381.3636	175554.	0.00
10.7200	-0.00396	23310.	-4394.	1.26E-04	0.00	1.65E+09	362.2942	175864.	0.00
10.8800	-0.00369	15509.	-3721.	1.48E-04	0.00	1.65E+09	338.5038	176242.	0.00
11.0400	-0.00339	8951.	-3097.	1.63E-04	0.00	1.65E+09	311.4980	176666.	0.00
11.2000	-0.00306	3540.	-2527.	1.70E-04	0.00	1.65E+09	282.5541	177115.	0.00
11.3600	-0.00273	-831.002	-2013.	1.72E-04	0.00	1.65E+09	252.7417	177573.	0.00
11.5200	-0.00240	-4270.	-1556.	1.69E-04	0.00	1.65E+09	222.9391	178028.	0.00
11.6800	-0.00209	-6886.	-1156.	1.62E-04	0.00	1.65E+09	193.8524	178469.	0.00
11.8400	-0.00178	-8785.	-810.534	1.53E-04	0.00	1.65E+09	166.0330	178888.	0.00
12.0000	-0.00150	-10070.	-516.844	1.42E-04	0.00	1.65E+09	139.8934	179280.	0.00
12.1600	-0.00124	-10837.	-271.451	1.30E-04	0.00	1.65E+09	115.7242	179640.	0.00
12.3200	-1.00E-03	-11174.	-70.394	1.17E-04	0.00	1.65E+09	93.7105	179965.	0.00
12.4800	-7.88E-04	-11162.	90.5577	1.04E-04	0.00	1.65E+09	73.9475	180257.	0.00
12.6400	-6.00E-04	-10875.	215.7446	9.12E-05	0.00	1.65E+09	56.4556	180513.	0.00
12.8000	-4.38E-04	-10376.	309.4890	7.88E-05	0.00	1.65E+09	41.1948	180735.	0.00
12.9600	-2.98E-04	-9723.	375.9904	6.71E-05	0.00	1.65E+09	28.0774	180925.	0.00
13.1200	-1.80E-04	-8964.	419.2454	5.62E-05	0.00	1.65E+09	16.9799	181085.	0.00
13.2800	-8.21E-05	-8140.	442.9888	4.62E-05	0.00	1.65E+09	7.7529	181217.	0.00
13.4400	-2.44E-06	-7285.	450.6532	3.73E-05	0.00	1.65E+09	0.2308	181324.	0.00
13.6000	6.10E-05	-6427.	445.3493	2.93E-05	0.00	1.65E+09	-5.756	181246.	0.00
13.7600	1.10E-04	-5589.	429.8566	2.23E-05	0.00	1.65E+09	-10.383	181181.	0.00
13.9200	1.47E-04	-4787.	406.6132	1.63E-05	0.00	1.65E+09	-13.829	181133.	0.00
14.0800	1.72E-04	-4035.	377.7209	1.11E-05	0.00	1.65E+09	-16.267	181100.	0.00
14.2400	1.89E-04	-3342.	344.9642	6.84E-06	0.00	1.65E+09	-17.855	181078.	0.00
14.4000	1.99E-04	-2713.	309.8339	3.31E-06	0.00	1.65E+09	-18.739	181067.	0.00
14.5600	2.02E-04	-2153.	273.5530	4.85E-07	0.00	1.65E+09	-19.053	181063.	0.00
14.7200	2.01E-04	-1663.	237.1035	-1.73E-06	0.00	1.65E+09	-18.915	181066.	0.00
14.8800	1.95E-04	-1242.	201.2558	-3.42E-06	0.00	1.65E+09	-18.427	181074.	0.00
15.0400	1.87E-04	-888.676	166.5960	-4.66E-06	0.00	1.65E+09	-17.677	181085.	0.00
15.2000	1.77E-04	-600.177	133.5543	-5.53E-06	0.00	1.65E+09	-16.741	181098.	0.00
15.3600	1.66E-04	-373.229	102.4315	-6.09E-06	0.00	1.65E+09	-15.678	181113.	0.00
15.5200	1.54E-04	-203.975	73.4244	-6.43E-06	0.00	1.65E+09	-14.537	181130.	0.00
15.6800	1.42E-04	-88.256	46.6500	-6.60E-06	0.00	1.65E+09	-13.353	181146.	0.00
15.8400	1.29E-04	-21.737	22.1676	-6.66E-06	0.00	1.65E+09	-12.150	181163.	0.00
16.0000	1.16E-04	0.00	0.00	-6.67E-06	0.00	1.65E+09	-10.942	90590.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.15366730 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -574350. inch-lbs
 Maximum shear force = 10370. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 10
 Number of zero deflection points = 2

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

Shear = 10370. lbs
 Slope = 0.00000
 Axial Load = 122470. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
16.00000	0.15366730	-574350.	10370.
15.20000	0.15392988	-574677.	10370.
14.40000	0.15573987	-577348.	10370.
13.60000	0.15293627	-573601.	10370.
12.80000	0.15571346	-577257.	10370.
12.00000	0.15378148	-574508.	10370.
11.20000	0.15820849	-580270.	-10702.
10.40000	0.16970596	-598350.	-11947.
9.60000	0.21642040	-674337.	10370.
8.80000	0.25197468	-747324.	10370.
8.00000	0.31874987	-691318.	10370.
7.20000	0.38581563	-632013.	10370.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 122470.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-2686089.	37232.	0.00	0.00	7.86E+09	0.00	0.00	0.00
0.1600	0.9994	-2614536.	37223.	-6.47E-04	0.00	7.86E+09	-4.370	8.3963	0.00
0.3200	0.9975	-2542849.	37210.	-0.00128	0.00	7.89E+09	-9.349	17.9952	0.00
0.4800	0.9945	-2471052.	37186.	-0.00189	0.00	7.90E+09	-14.781	28.5370	0.00
0.6400	0.9903	-2399167.	37153.	-0.00248	0.00	7.91E+09	-20.468	39.6849	0.00
0.8000	0.9850	-2327221.	37108.	-0.00305	0.00	7.92E+09	-26.276	51.2212	0.00
0.9600	0.9786	-2255239.	37052.	-0.00360	0.00	7.93E+09	-32.095	62.9716	0.00
1.1200	0.9711	-2183247.	36985.	-0.00414	0.00	7.95E+09	-37.829	74.7915	0.00
1.2800	0.9627	-2111271.	36907.	-0.00466	0.00	7.96E+09	-43.280	86.3218	0.00
1.4400	0.9532	-2039334.	36818.	-0.00516	0.00	7.97E+09	-48.734	98.1603	0.00
1.6000	0.9428	-1967461.	36720.	-0.00564	0.00	7.98E+09	-54.102	110.1725	0.00
1.7600	0.9316	-1895677.	36611.	-0.00611	0.00	8.00E+09	-59.029	121.6623	0.00
1.9200	0.9194	-1824003.	36493.	-0.00655	0.00	8.01E+09	-63.786	133.2066	0.00
2.0800	0.9064	-1752461.	36367.	-0.00698	0.00	8.02E+09	-68.085	144.2236	0.00
2.2400	0.8926	-1681072.	36232.	-0.00739	0.00	8.04E+09	-71.741	154.3190	0.00
2.4000	0.8780	-1609853.	36090.	-0.00778	0.00	8.06E+09	-76.511	167.3126	0.00
2.5600	0.8627	-1538826.	35939.	-0.00816	0.00	8.07E+09	-80.853	179.9456	0.00
2.7200	0.8467	-1468011.	35779.	-0.00852	0.00	8.09E+09	-85.223	193.2586	0.00
2.8800	0.8300	-1397428.	35610.	-0.00886	0.00	8.11E+09	-91.412	211.4622	0.00
3.0400	0.8127	-1327104.	35429.	-0.00918	0.00	8.13E+09	-97.520	230.3982	0.00
3.2000	0.7947	-1257066.	35236.	-0.00948	0.00	8.16E+09	-103.511	250.0680	0.00
3.3600	0.7763	-1187340.	35031.	-0.00977	0.00	8.18E+09	-109.353	270.4735	0.00
3.5200	0.7572	-1117952.	34816.	-0.01004	0.00	8.21E+09	-115.011	291.6162	0.00
3.6800	0.7377	-1048926.	34588.	-0.01029	0.00	8.24E+09	-122.514	318.8630	0.00
3.8400	0.7177	-980294.	34344.	-0.01053	0.00	8.27E+09	-131.544	351.9035	0.00
4.0000	0.6973	-912094.	34082.	-0.01075	0.00	8.31E+09	-140.847	387.8335	0.00
4.1600	0.6764	-844363.	33803.	-0.01095	0.00	8.35E+09	-150.420	426.9525	0.00
4.3200	0.6552	-777141.	33505.	-0.01114	0.00	8.39E+09	-160.257	469.6020	0.00
4.4800	0.6337	-710468.	33187.	-0.01131	0.00	8.44E+09	-170.360	516.1844	0.00
4.6400	0.6118	-644385.	32849.	-0.01146	0.00	8.50E+09	-181.452	569.4407	0.00
4.8000	0.5897	-578937.	32490.	-0.01160	0.00	8.57E+09	-192.889	628.0659	0.00
4.9600	0.5673	-514170.	32108.	-0.01172	0.00	8.65E+09	-204.672	692.7383	0.00
5.1200	0.5447	-450130.	31704.	-0.01183	0.00	8.73E+09	-216.800	764.2507	0.00
5.2800	0.5219	-386865.	31276.	-0.01192	0.00	8.95E+09	-229.274	843.5352	0.00
5.4400	0.4989	-324427.	30823.	-0.01199	0.00	8.95E+09	-242.093	931.6906	0.00

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5.6000	0.4758	-262865.	30346.	-0.01206	0.00	8.95E+09	-255.257	1030.	0.00
5.7600	0.4526	-202230.	29842.	-0.01211	0.00	8.95E+09	-268.767	1140.	0.00
5.9200	0.4293	-142576.	29313.	-0.01214	0.00	8.95E+09	-282.622	1264.	0.00
6.0800	0.4060	-83957.	28757.	-0.01217	0.00	8.95E+09	-296.822	1404.	0.00
6.2400	0.3826	-26428.	28185.	-0.01218	0.00	8.95E+09	-299.040	1501.	0.00
6.4000	0.3592	30001.	27611.	-0.01218	0.00	8.95E+09	-298.628	1596.	0.00
6.5600	0.3358	85327.	27039.	-0.01217	0.00	8.95E+09	-297.181	1699.	0.00
6.7200	0.3125	139553.	26471.	-0.01214	0.00	8.95E+09	-294.670	1811.	0.00
6.8800	0.2892	192686.	25909.	-0.01211	0.00	8.95E+09	-291.067	1932.	0.00
7.0400	0.2660	244736.	25354.	-0.01206	0.00	8.95E+09	-286.348	2067.	0.00
7.2000	0.2429	295718.	24810.	-0.01200	0.00	8.95E+09	-280.489	2217.	0.00
7.3600	0.2199	345651.	24278.	-0.01193	0.00	8.95E+09	-273.473	2388.	0.00
7.5200	0.1971	394559.	23761.	-0.01185	0.00	8.95E+09	-265.282	2585.	0.00
7.6800	0.1744	442469.	23261.	-0.01176	0.00	8.74E+09	-255.880	2817.	0.00
7.8400	0.1519	489412.	22780.	-0.01166	0.00	8.68E+09	-244.523	3091.	0.00
8.0000	0.1296	535429.	18610.	-0.01155	0.00	8.62E+09	-4099.	60725.	0.00
8.1600	0.1076	566307.	7869.	-0.01142	0.00	8.58E+09	-7090.	126561.	0.00
8.3200	0.08574	571019.	-5074.	-0.01130	0.00	8.58E+09	-6393.	143148.	0.00
8.4800	0.06418	552136.	-16481.	-0.01117	0.00	8.60E+09	-5490.	164237.	0.00
8.6400	0.04285	512987.	-25863.	-0.01105	0.00	8.65E+09	-4284.	191953.	0.00
8.8000	0.02174	458020.	-32475.	-0.01094	0.00	8.72E+09	-2604.	230031.	0.00
8.9600	8.19E-04	393430.	-35092.	-0.01085	0.00	8.95E+09	-121.791	285687.	0.00
9.1200	-0.01994	328371.	-33655.	-0.00570	0.00	6.17E+07	1619.	155905.	0.00
9.2800	-0.02108	266878.	-30469.	-3.08E-04	0.00	8.85E+08	1699.	154746.	0.00
9.4400	-0.02112	211513.	-27203.	1.42E-04	0.00	1.27E+09	1703.	154804.	0.00
9.6000	-0.02054	162350.	-23972.	4.03E-04	0.00	1.55E+09	1664.	155522.	0.00
9.7600	-0.01957	119272.	-20842.	5.74E-04	0.00	1.64E+09	1597.	156660.	0.00
9.9200	-0.01834	82048.	-17859.	6.91E-04	0.00	1.65E+09	1510.	158100.	0.00
10.0800	-0.01692	50367.	-15059.	7.68E-04	0.00	1.65E+09	1408.	159760.	0.00
10.2400	-0.01538	23861.	-12464.	8.12E-04	0.00	1.65E+09	1295.	161570.	0.00
10.4000	-0.01380	2121.	-10094.	8.27E-04	0.00	1.65E+09	1175.	163468.	0.00
10.5600	-0.01221	-15288.	-7956.	8.19E-04	0.00	1.65E+09	1052.	165401.	0.00
10.7200	-0.01065	-28815.	-6055.	7.93E-04	0.00	1.65E+09	928.5316	167323.	0.00
10.8800	-0.00916	-38911.	-4388.	7.54E-04	0.00	1.65E+09	807.5202	169195.	0.00
11.0400	-0.00776	-46020.	-2950.	7.04E-04	0.00	1.65E+09	691.0242	170985.	0.00
11.2000	-0.00646	-50569.	-1729.	6.48E-04	0.00	1.65E+09	580.8142	172667.	0.00
11.3600	-0.00527	-52963.	-711.912	5.88E-04	0.00	1.65E+09	478.2521	174223.	0.00
11.5200	-0.00420	-53579.	116.1485	5.26E-04	0.00	1.65E+09	384.3104	175639.	0.00
11.6800	-0.00325	-52764.	772.7013	4.64E-04	0.00	1.65E+09	299.5988	176909.	0.00
11.8400	-0.00242	-50830.	1276.	4.03E-04	0.00	1.65E+09	224.4003	178030.	0.00
12.0000	-0.00170	-48055.	1644.	3.46E-04	0.00	1.65E+09	158.7128	179004.	0.00
12.1600	-0.00109	-44682.	1894.	2.92E-04	0.00	1.65E+09	102.2951	179835.	0.00
12.3200	-5.82E-04	-40919.	2045.	2.42E-04	0.00	1.65E+09	54.7142	180532.	0.00
12.4800	-1.63E-04	-36943.	2112.	1.97E-04	0.00	1.65E+09	15.3922	181104.	0.00
12.6400	1.73E-04	-32901.	2111.	1.56E-04	0.00	1.65E+09	-16.308	181093.	0.00
12.8000	4.35E-04	-28909.	2056.	1.20E-04	0.00	1.65E+09	-40.986	180738.	0.00
12.9600	6.33E-04	-25061.	1960.	8.85E-05	0.00	1.65E+09	-59.523	180475.	0.00
13.1200	7.75E-04	-21425.	1833.	6.14E-05	0.00	1.65E+09	-72.778	180288.	0.00
13.2800	8.69E-04	-18052.	1685.	3.84E-05	0.00	1.65E+09	-81.540	180167.	0.00
13.4400	9.22E-04	-14975.	1523.	1.92E-05	0.00	1.65E+09	-86.531	180100.	0.00
13.6000	9.43E-04	-12212.	1355.	3.34E-06	0.00	1.65E+09	-88.402	180077.	0.00
13.7600	9.35E-04	-9772.	1186.	-9.46E-06	0.00	1.65E+09	-87.729	180091.	0.00
13.9200	9.06E-04	-7652.	1020.	-1.96E-05	0.00	1.65E+09	-85.021	180133.	0.00
14.0800	8.60E-04	-5844.	861.2863	-2.75E-05	0.00	1.65E+09	-80.716	180197.	0.00
14.2400	8.01E-04	-4332.	711.6169	-3.34E-05	0.00	1.65E+09	-75.189	180278.	0.00
14.4000	7.32E-04	-3096.	573.4321	-3.77E-05	0.00	1.65E+09	-68.753	180371.	0.00
14.5600	6.56E-04	-2112.	448.2327	-4.07E-05	0.00	1.65E+09	-61.663	180472.	0.00
14.7200	5.75E-04	-1356.	337.0778	-4.27E-05	0.00	1.65E+09	-54.123	180579.	0.00
14.8800	4.92E-04	-797.859	240.6804	-4.40E-05	0.00	1.65E+09	-46.291	180689.	0.00
15.0400	4.07E-04	-410.621	159.4914	-4.47E-05	0.00	1.65E+09	-38.281	180801.	0.00
15.2000	3.20E-04	-164.391	93.7729	-4.50E-05	0.00	1.65E+09	-30.175	180914.	0.00
15.3600	2.34E-04	-29.355	43.6604	-4.51E-05	0.00	1.65E+09	-22.025	181027.	0.00
15.5200	1.47E-04	24.4957	9.2125	-4.51E-05	0.00	1.65E+09	-13.858	181139.	0.00
15.6800	6.02E-05	27.2529	-9.550	-4.51E-05	0.00	1.65E+09	-5.686	181250.	0.00
15.8400	-2.64E-05	9.0403	-12.620	-4.51E-05	0.00	1.65E+09	2.4888	181294.	0.00
16.0000	-1.13E-04	0.00	0.00	-4.51E-05	0.00	1.65E+09	10.6570	90592.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses

are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

* WARNING: Some values of computed curvature exceeded the maximum curvature calculated or entered by the user
 Depth = 9.1200 ft Computed Curv. = 0.00532 rad/in Maximum Curv. = 8.49E-04 rad/in

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -2686089. inch-lbs
 Maximum shear force = 37232. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 23
 Number of zero deflection points = 3

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	21320.	S, rad	0.00	169870.	0.3971	0.00	-21890.	-1302450.
2	V, lb	10370.	S, rad	0.00	122470.	0.1537	0.00	10370.	-574350.
3	y, in	1.0000	S, rad	0.00	122470.	1.0000	0.00	37232.	-2686089.






Maximum pile-head deflection = 1.000000000 inches
 Maximum pile-head rotation = -0.000000000 radians = -0.000000 deg.

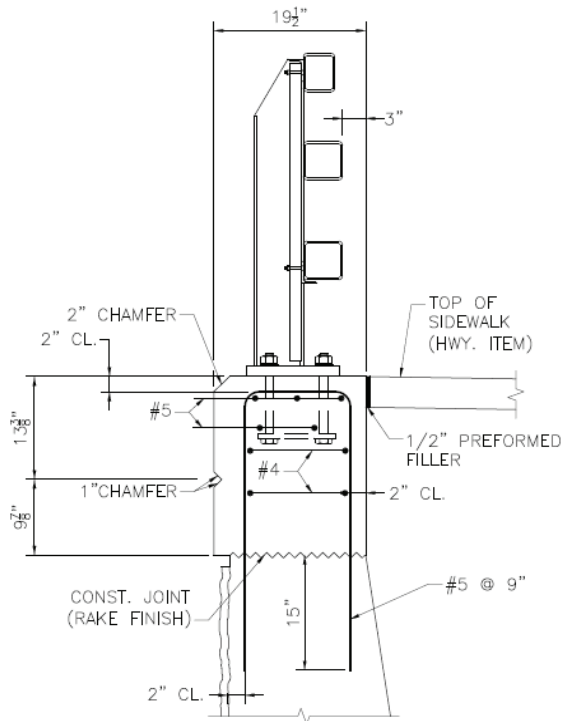
The analysis ended normally.

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023	
Detail: Unfactored Vertical Load	Checked by: JG	Date: 5/2023	

Wingwall Type 2A

Unfactored Vertical Load

	W (ft)	H (ft)	unit weight		
Coping	(1.63)	(1.94)	(0.15 kcf)	=	0.47 k/ft
Stem Bottom 	(1.54)	(22.31)	(0.15 kcf)	=	5.16 k/ft
Stem 	0.5 (1.81)	(16.25)	(0.15 kcf)	=	2.21 k/ft
Concrete Footing	(12.00)	(3.50)	(0.15 kcf)	=	6.30 k/ft
Vertical Soil top 	(7.08)	(8.00)	(0.12 kcf)	=	6.80 k/ft
Vertical Soil bot 1 	0.5 (1.81)	(16.25)	(0.12 kcf)	=	1.77 k/ft
Vertical Soil bot 2 	(5.27)	(16.25)	(0.12 kcf)	=	10.28 k/ft
Bridge Railing S3-TL4 at Sidewalk				=	0.090 k/ft



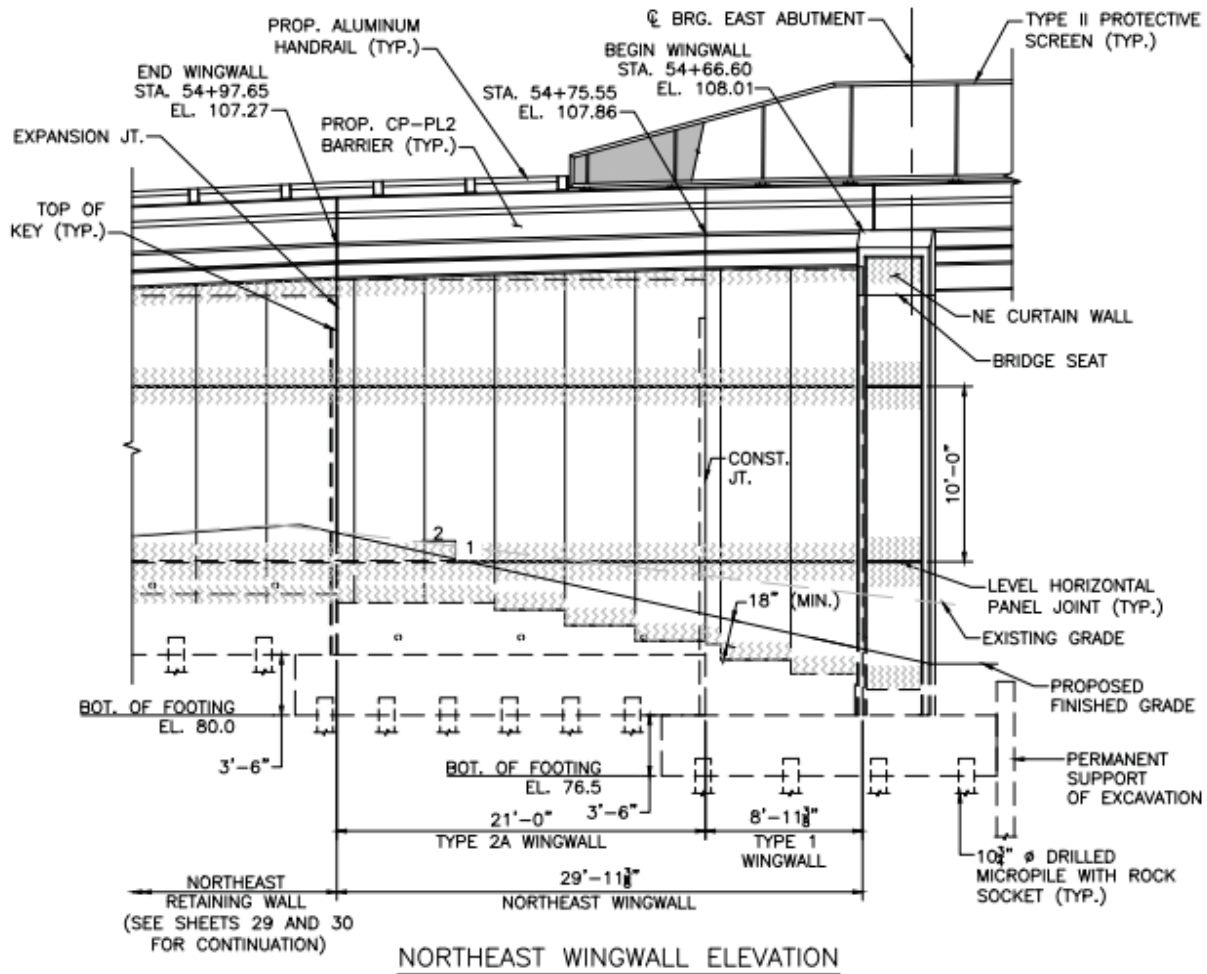
TOP OF U-WINGWALL/RETAINING WALL
DETAILS AT SIDEWALK

LAMSON ENGINEERING CORPORATION				Final Page No.:	
Project:	Bridge No. W-38-003		Job No.:	Preliminary Sheet No.:	
Subject:	Wingwall - 10.75 Micropile		Prepared by: SL	Date: 5/2023	
Detail:	Unfactored Vertical Load		Checked by: JG	Date: 5/2023	

Wingwall Type 2A

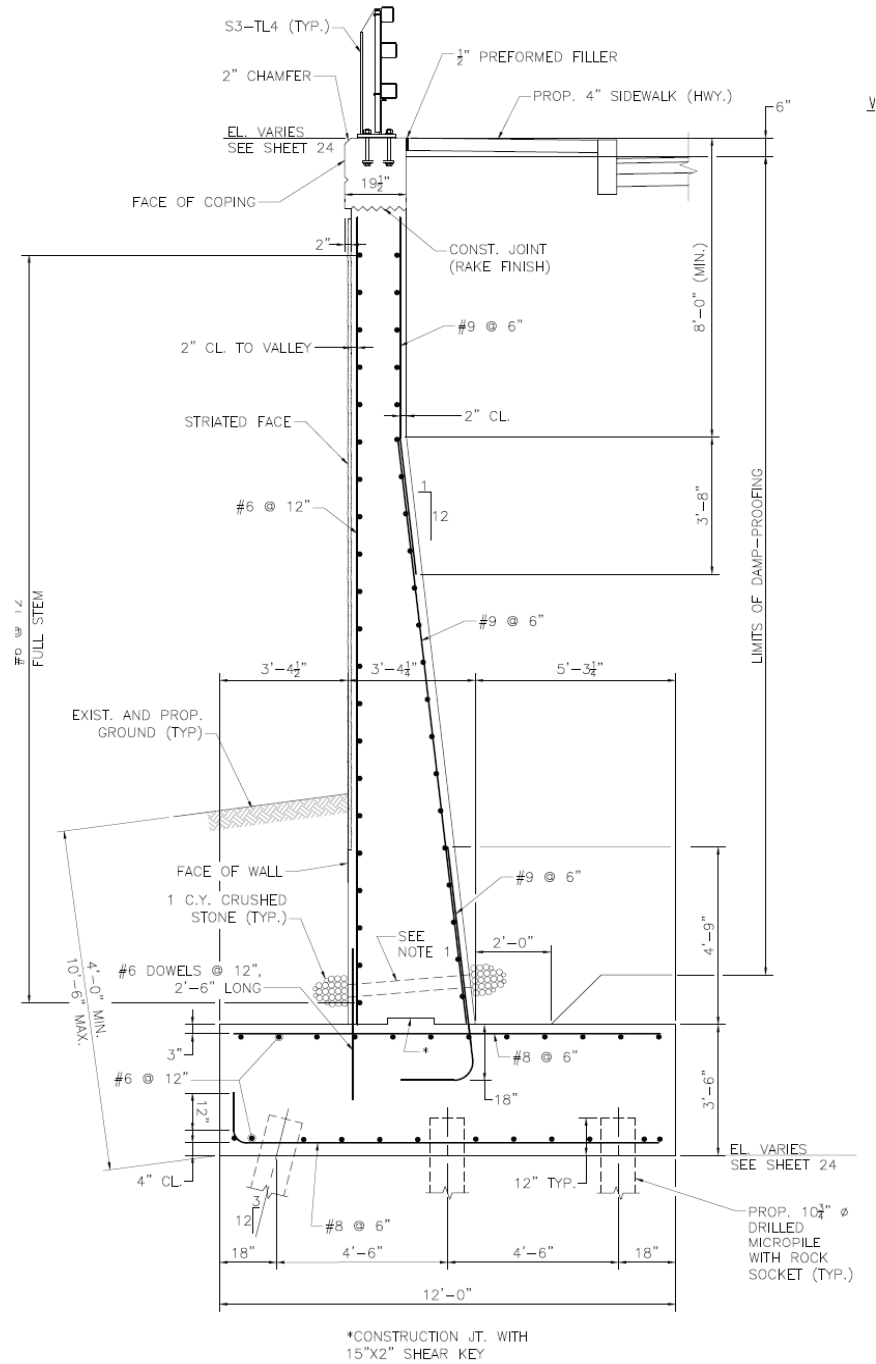
STA.	Elevation	STA.	Elevation	Chord Length (ft.)	Bottom of Footing Elevation	Design H at highest 1/4 point (ft)	
54+02.43	107.07	53+80.18	106	22	82	24.80	SW Wingwall
54+90.19	108.06	54+67.44	107.95	23	81.5	26.53	SE Wingwall
54+10.54	107.34	53+88.54	106.32	22	82	25.09	NW Wingwall
54+75.55	107.86	54+97.65	107.27	22	80	27.71	NE Wingwall

By Investigations above, NE wingwall controls for micropile design. Say Design Height = 27.75 ft



LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023	
Detail: Unfactored Vertical Load	Checked by: JG	Date: 5/2023	

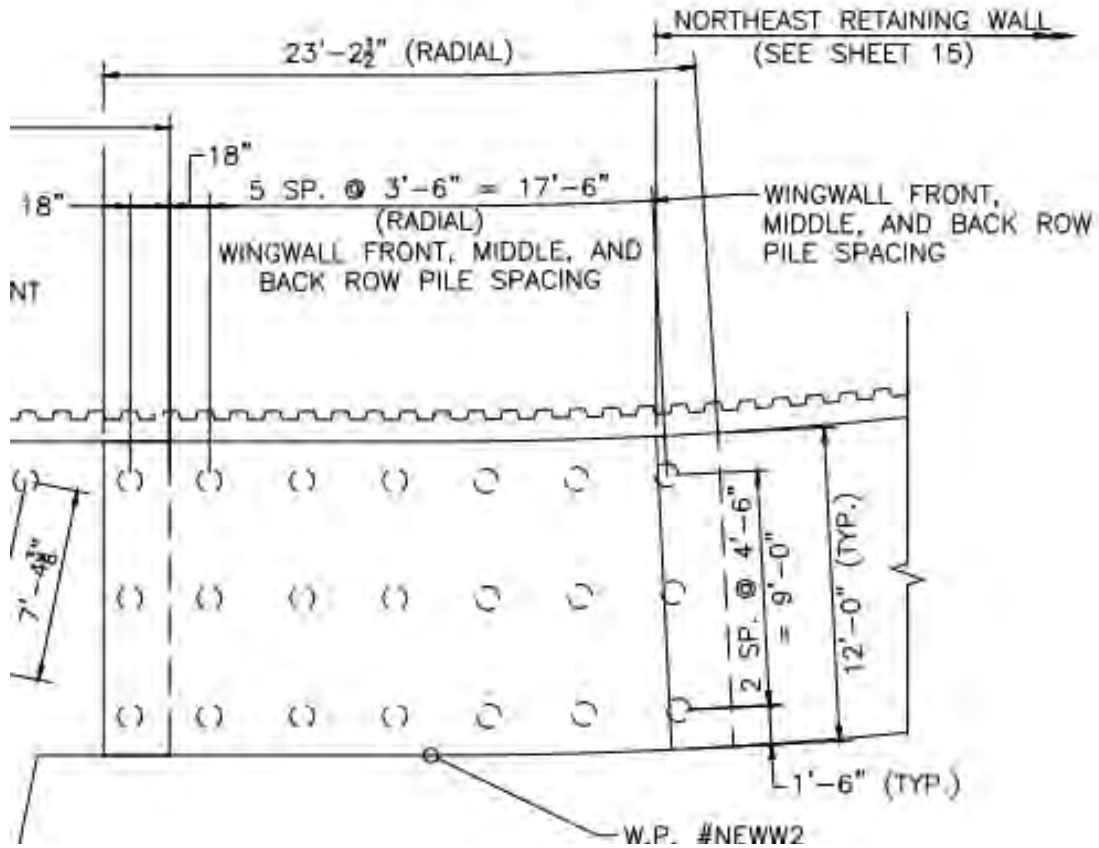
Wingwall Type 2A



WINGWALL TYPE 2A TYPICAL SECTION

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023	
Detail: Unfactored Vertical Load	Checked by: JG	Date: 5/2023	

Wingwall Type 2A



LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023
Detail: Lateral earth pressure	Checked by: JG	Date: 5/2023

Determine Unfactored Horizontal Load

Effective angle of internal friction ϕ'_f	=	37	degree
Friction angle between fill and wall, δ	=	0	degree
Angle of fill to the horizontal, β	=	0.00	degree
Angle of back of wall to the horizontal, θ	=	90	degree
Unit weight of soil, γ_{soil}	=	0.125	kcf
Total unit weight of water, γ_w	=	0.0624	kcf
Height of Soil	=	27.75	ft ±
Distance from back of wall to footing heel, B_{heel}	=	7.08	ft
Height of fill behind footing at heel, $h = H + B_{heel} \tan \beta$	=	27.75	ft ±
Height of water from bottom of footing, H_w	=	0	ft

Lateral Earth Pressure (EH)

$$K_a = \frac{\sin^2(\theta + \phi'_f)}{\sin^2\theta \sin(\theta - \delta) \left[1 + \sqrt{\frac{\sin(\phi'_f + \delta) \sin(\phi'_f - \beta)}{\sin(\theta - \delta) \sin(\theta + \beta)}} \right]^2}$$

$$= 0.249$$

$$K_o = 1 - \sin \phi'_f = 1 - \sin(37)$$

$$= 0.398$$

Per *massDOT* LRFD BM 3.1.5

Founded on Pile = Y (Input Y if yes)

$$K_e = K_o = 0.398$$

$$P_{e1} = 0.5 K_e \gamma_{soil} (h - H_w)^2$$

$$= 0.5 \times 0.398 \times 0.125 \text{ kcf} \times (27.75 \text{ ft} - 0 \text{ ft})^2$$

$$= 19.16 \text{ k/ft length of wall}$$

$$P_{ev1} = P_{e1} \sin(90 - \theta + \delta)$$

$$= 19.16 \text{ k/ft} \times \sin(90 - 90 + 0)$$

$$= 0.00 \text{ k/ft}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023
Detail: Lateral earth pressure	Checked by: JG	Date: 5/2023

$$\begin{aligned}
 \text{Horizontal component of } P_{e1}, P_{eh1} &= P_{e1} \cos (90 - \theta + \delta) \\
 &= 19.16 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 19.16 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Lateral earth pressure, } P_{e2} &= K_e \gamma_{\text{soil}} (h - H_w) H_w \\
 &= 0.398 \times 0.125 \text{ kcf} \times (27.75 \text{ ft} - 0 \text{ ft}) \times 0 \text{ ft} \\
 &= 0.00 \text{ k/ft length of wall}
 \end{aligned}$$

$$\begin{aligned}
 \text{Vertical component of } P_{e2}, P_{ev2} &= P_{e2} \sin (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Horizontal component of } P_{e2}, P_{eh2} &= P_{e2} \cos (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Lateral earth pressure, } P_{e3} &= 0.5 K_e \gamma' (H_w)^2 \\
 &= 0.5 \times 0.398 \times (0.125 \text{ kcf} - 0.0624 \text{ kcf}) \times 0 \text{ ft}^2 \\
 &= 0.00 \text{ k/ft length of wall}
 \end{aligned}$$

$$\begin{aligned}
 \text{Vertical component of } P_{e3}, P_{ev3} &= P_{e3} \sin (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \sin (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Horizontal component of } P_{e3}, P_{eh3} &= P_{e3} \cos (90 - \theta + \delta) \\
 &= 0 \text{ k/ft} \times \cos (90 - 90 + 0) \\
 &= 0.00 \text{ k/ft}
 \end{aligned}$$

Live Load Surcharge (LS) (AASHTO LRFD 3.11.6.4)

$$\text{Equivalent height of soil for, } h_{eq} = 2.000 \text{ ft}$$

LAMSON ENGINEERING CORPORATION		Final Page No.:
Project: Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date: 5/2023
Detail: Lateral earth pressure	Checked by: JG	Date: 5/2023

$$\begin{aligned} \text{Vertical live load Surcharge on heel, LS} &= 0.125 \text{ kcf} \times 2 \text{ ft} \times 7.083 \text{ ft} \\ &= 1.771 \text{ k / ft} \end{aligned}$$

$$\begin{aligned} \text{Horizontal earth pressure due to live load surcharge } \Delta_p &= K_e \gamma_{\text{soil}} h_{eq} \\ &= 0.398 \times 0.125 \text{ kcf} \times 2 \text{ ft} \\ &= 0.10 \text{ ksf} \end{aligned}$$

$$\begin{aligned} \text{Live load lateral earth pressure, } P_{LS} &= \Delta_p h \\ &= 0.1 \text{ ksf} \times 27.75 \text{ ft} \\ &= 2.76 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Vertical component of } P_{LS}, P_{LSV} &= P_{LS} \sin (90 - \alpha + \delta) \\ &= 2.76 \text{ k/ft} \times \sin (90 - 90 + 0) \\ &= 0.00 \text{ k/ft length of wall} \end{aligned}$$





$$\begin{aligned} \text{Horizontal component of } P_{LS}, P_{LSH} &= P_{LS} \cos (90 - \alpha + \delta) \\ &= 2.76 \text{ k/ft} \times \cos (90 - 90 + 0) \\ &= 2.76 \text{ k/ft length of wall} \end{aligned}$$

$$\begin{aligned} \text{Unfactored horizontal load, EH + LSH} &= P_{eh1} + P_{eh2} + P_{eh3} + P_{LSH} \\ &= 19.16 + 0 + 0 + 2.76 \\ &= \underline{21.93 \text{ k/ft length of wall}} \end{aligned}$$

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project:	Bridge No. W-38-003	Job No.:	Preliminary Sheet No.:	
Subject:	Wingwall - 10.75 Micropile	Prepared by: SL		Date: 5/2023
Detail:	Strength I for Overturning	Checked by: JG		Date: 5/2023

Summary of Factored Loads - Strength IA: 1.25DC + 1.35EH + 1.35EV + 1.75 LS

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (k/ft)	Factored vertical load, V_u (k/ft)	Arm about CL Footing	Factored Moment	
Coping	1.25	0.47	0.59	1.90	1.12	
Stem 	1.25	5.16	6.45	1.85	11.96	
Stem Bottom 	1.25	2.21	2.76	0.48	1.32	
Concrete Footing	1.25	6.30	7.88	0.00	0.00	
Vertical Soil top	1.35	6.80	9.18	-2.46	-22.57	
Vertical Soil bot 1 	1.35	1.77	2.39	-0.13	-0.30	
Vertical Soil bot 2 	1.35	10.28	13.88	-3.36	-46.69	
Bridge Railing	1.25	0.09	0.11	1.90	0.21	
P_{v1}	1.35	0.00	0.00	-6.00	0.00	
P_{v2}	1.35	0.00	0.00	-6.00	0.00	
P_{v3}	1.35	0.00	0.00	-6.00	0.00	
P_{LSV}	1.75	0.00	0.00	-6.00	0.00	
LS	1.75	1.77	3.10	-3.36	-10.43	
TOTAL		34.85	46.33		-65.36	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (k/ft)	Factored horizontal load, H_u (k/ft)	Arm about CL Footing	Factored Moment	
P_{h1}	1.35	19.16	25.87	9.25	239.31	
P_{h2}	1.35	0.00	0.00	0.00	0.00	
P_{h3}	1.35	0.00	0.00	0.00	0.00	
P_{LSH}	1.75	2.76	4.83	13.88	67.07	
TOTAL		21.93	30.71		306.39	ΣM_H

LAMSON ENGINEERING CORPORATION		Final Page No.:	
Project: Bridge No. W-38-003, Wilmington	Job No.:	Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL	Date:	12/2022
Detail: Pile_STR I_VMAX	Checked by: JG/FL	Date:	12/2022

Pile STR I_VMAX

Cross Section = 0.63 ft.²

Number of Pile, n = 21

Length to Wall 23.2 ft

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Horizontal Resistance (Front Piles battered 1:4) = 163.53 x 7 ea / 4 = 286.2 kips

Vertical, F_z = 1074.83 kips

F_y = 712.38 - 286.18 = 426.19 kips

F_x = 0.00 kips

M_x = (-65.36+306.39) k-ft/ft x 23.2 ft + 1074.83 k x 0 ft
= 5591.77 k-ft

M_y = 0.00 kips-ft

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	M _x (Y _{C.G.} - Y _i) Σ (Y _i - Y _{C.G.}) ²	M _y (X _{C.G.} - X _i) Σ (X _i - X _{C.G.}) ²	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	0.00	-4.50	0.000	-2.836	101.434	20.250	88.76	0.00	51.182	139.94	20.29	0.00
2	0.63	3.00	-4.50	1.891	-2.836	50.005	20.250	88.76	0.00	51.182	139.94	20.29	0.00
3	0.63	6.50	-4.50	4.097	-2.836	12.755	20.250	88.76	0.00	51.182	139.94	20.29	0.00
4	0.63	10.00	-4.50	6.303	-2.836	0.005	20.250	88.76	0.00	51.182	139.94	20.29	0.00
5	0.63	13.50	-4.50	8.509	-2.836	11.755	20.250	88.76	0.00	51.182	139.94	20.29	0.00
6	0.63	17.00	-4.50	10.715	-2.836	48.005	20.250	88.76	0.00	51.182	139.94	20.29	0.00
7	0.63	20.50	-4.50	12.921	-2.836	108.755	20.250	88.76	0.00	51.182	139.94	20.29	0.00
1	0.63	0.00	0.00	0.000	0.000	101.434	0.000	0.00	0.00	51.182	51.18	20.29	0.00
2	0.63	3.00	0.00	1.891	0.000	50.005	0.000	0.00	0.00	51.182	51.18	20.29	0.00
3	0.63	6.50	0.00	4.097	0.000	12.755	0.000	0.00	0.00	51.182	51.18	20.29	0.00
4	0.63	10.00	0.00	6.303	0.000	0.005	0.000	0.00	0.00	51.182	51.18	20.29	0.00
5	0.63	13.50	0.00	8.509	0.000	11.755	0.000	0.00	0.00	51.182	51.18	20.29	0.00
6	0.63	17.00	0.00	10.715	0.000	48.005	0.000	0.00	0.00	51.182	51.18	20.29	0.00
7	0.63	20.50	0.00	12.921	0.000	108.755	0.000	0.00	0.00	51.182	51.18	20.29	0.00
1	0.63	0.00	4.50	0.000	2.836	101.434	20.250	-88.76	0.00	51.182	-37.58	20.29	0.00
2	0.63	3.00	4.50	1.89	2.84	50.01	20.25	-88.76	0.00	51.18	-37.58	20.29	0.00
3	0.63	6.50	4.50	4.097	2.836	12.755	20.250	-88.76	0.00	51.182	-37.58	20.29	0.00
4	0.63	10.00	4.50	6.303	2.836	0.005	20.250	-88.76	0.00	51.182	-37.58	20.29	0.00
5	0.63	13.50	4.50	8.509	2.836	11.755	20.250	-88.76	0.00	51.182	-37.58	20.29	0.00
6	0.63	17.00	4.50	10.715	2.836	48.005	20.250	-88.76	0.00	51.182	-37.58	20.29	0.00
7	0.63	20.50	4.50	12.921	2.836	108.755	20.250	-88.76	0.00	51.182	-37.58	20.29	0.00
21	13.24			133.31	0.00						139.94 -37.58	20.29 20.29	

X_{C.G.} = ΣA_p X_i / ΣA_p = 133.31 / 13.24 = 10.071 ft. Y_{C.G.} = ΣA_p Y_i / ΣA_p = 0.00 / 13.24 = 0.000 ft. from Pile Cap Center

Σ(X_i - X_{C.G.})² = 998 ft.² Σ(Y_i - Y_{C.G.})² = 283.50 ft.²

Resultant Shear on Single Pile = (20.29² + 0.00²)^{0.5} = 20.29 kips

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project: Bridge No. W-38-003	Job No.:		Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL		Date: 5/2023	
Detail: Strength I for Sliding and Eccentricity	Checked by: JG		Date: 5/2023	

Summary of Factored Loads - Strength IB: 0.90DC + 1.35EH + 1.0EV + 1.75 LS

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (k/ft)	Factored vertical load, V_u (k/ft)	Arm about CL Footing	Factored Moment	
Coping	0.90	0.47	0.43	1.90	0.81	
Stem	0.90	5.16	4.64	1.85	8.61	
Stem Bottom	0.90	2.21	1.99	0.48	0.95	
Concrete Footing	0.90	6.30	5.67	0.00	0.00	
Vertical Soil top	1.00	6.80	6.80	-2.46	-16.72	
Vertical Soil bot 1	1.00	1.77	1.77	-0.13	-0.22	
Vertical Soil bot 2	1.00	10.28	10.28	-3.36	-34.58	
Bridge Railing	0.90	0.09	0.08	1.90	0.15	
P_{v1}	1.35	0.00	0.00	-6.00	0.00	
P_{v2}	1.35	0.00	0.00	-6.00	0.00	
P_{v3}	1.35	0.00	0.00	-6.00	0.00	
P_{LSV}	1.75	0.00	0.00	-6.00	0.00	
LS	1.75	0.00	0.00	-3.36	0.00	
TOTAL		33.08	31.65		-41.00	ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (k/ft)	Factored horizontal load, H_u (k/ft)	Arm about CL Footing	Factored Moment	
P_{h1}	1.35	19.16	25.87	9.25	239.31	
P_{h2}	1.35	0.00	0.00	0.00	0.00	
P_{h3}	1.35	0.00	0.00	0.00	0.00	
P_{LSH}	1.75	2.76	4.83	13.88	67.07	
TOTAL		21.93	30.71		306.39	ΣM_H

LAMSON ENGINEERING CORPORATION				Final Page No.:	
Project: Bridge No. W-38-003, Wilmington		Job No.:		Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile		Prepared by: SL		Date: 12/2022	
Detail: Pile_STR I_VMIN		Checked by: JG/FL		Date: 12/2022	

Pile STR I_VMIN

Cross Section = 0.63 ft.²

Number of Pile, n = 21

Length between Expansion Joints = 23.2 ft

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Horizontal Resistance (Front Piles battered 1:4) = 163.53 x 7 ea / 4 = 286.2 kips

Vertical, F_z = 734.35 kips

F_y = 712.38 - 286.18 = 426.19 kips

F_x = 0.00 kips

M_x = (-41+306.39) k-ft/ft x 23.2 ft + 734.35 k x 0 ft
= 6157.07 k-ft

M_y = 0.00 kips-ft

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	M _x (Y _{C.G.} - Y _i) Σ (Y _i - Y _{C.G.}) ²	M _y (X _{C.G.} - X _i) Σ (X _i - X _{C.G.}) ²	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	0.00	-4.50	0.000	-2.836	101.434	20.250	97.73	0.00	34.969	132.70	20.29	0.00
2	0.63	3.00	-4.50	1.891	-2.836	50.005	20.250	97.73	0.00	34.969	132.70	20.29	0.00
3	0.63	6.50	-4.50	4.097	-2.836	12.755	20.250	97.73	0.00	34.969	132.70	20.29	0.00
4	0.63	10.00	-4.50	6.303	-2.836	0.005	20.250	97.73	0.00	34.969	132.70	20.29	0.00
5	0.63	13.50	-4.50	8.509	-2.836	11.755	20.250	97.73	0.00	34.969	132.70	20.29	0.00
6	0.63	17.00	-4.50	10.715	-2.836	48.005	20.250	97.73	0.00	34.969	132.70	20.29	0.00
7	0.63	20.50	-4.50	12.921	-2.836	108.755	20.250	97.73	0.00	34.969	132.70	20.29	0.00
1	0.63	0.00	0.00	0.000	0.000	101.434	0.000	0.00	0.00	34.969	34.97	20.29	0.00
2	0.63	3.00	0.00	1.891	0.000	50.005	0.000	0.00	0.00	34.969	34.97	20.29	0.00
3	0.63	6.50	0.00	4.097	0.000	12.755	0.000	0.00	0.00	34.969	34.97	20.29	0.00
4	0.63	10.00	0.00	6.303	0.000	0.005	0.000	0.00	0.00	34.969	34.97	20.29	0.00
5	0.63	13.50	0.00	8.509	0.000	11.755	0.000	0.00	0.00	34.969	34.97	20.29	0.00
6	0.63	17.00	0.00	10.715	0.000	48.005	0.000	0.00	0.00	34.969	34.97	20.29	0.00
7	0.63	20.50	0.00	12.921	0.000	108.755	0.000	0.00	0.00	34.969	34.97	20.29	0.00
1	0.63	0.00	4.50	0.000	2.836	101.434	20.250	-97.73	0.00	34.969	-62.76	20.29	0.00
2	0.63	3.00	4.50	1.891	2.836	50.005	20.250	-97.73	0.00	34.969	-62.76	20.29	0.00
3	0.63	6.50	4.50	4.10	2.84	12.76	20.25	-97.73	0.00	34.97	-62.76	20.29	0.00
4	0.63	10.00	4.50	6.30	2.84	0.01	20.25	-97.73	0.00	34.97	-62.76	20.29	0.00
5	0.63	13.50	4.50	8.51	2.84	11.76	20.25	-97.73	0.00	34.97	-62.76	20.29	0.00
6	0.63	17.00	4.50	10.72	2.84	48.01	20.25	-97.73	0.00	34.97	-62.76	20.29	0.00
7	0.63	20.50	4.50	12.92	2.84	108.76	20.25	-97.73	0.00	34.97	-62.76	20.29	0.00
21	13.24			133.31	0.00						132.70	20.29	
											-62.76	20.29	

X_{C.G.} = ΣA_p X_i / ΣA_p = 133.31 / 13.24 = 10.071 ft. Y_{C.G.} = ΣA_p Y_i / ΣA_p = 0.00 / 13.24 = 0.000 ft.

Σ(X_i - X_{C.G.})² = 998 ft.² Σ(Y_i - Y_{C.G.})² = 283.50 ft.²

Resultant Shear on Single Pile = (20.29² + 0.00²)^{0.5} = 20.29 kips

LAMSON ENGINEERING CORPORATION			Final Page No.:	
Project: Bridge No. W-38-003	Job No.:		Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile	Prepared by: SL		Date: 5/2023	
Detail: Service I for Settlement	Checked by: JG		Date: 5/2023	

Summary of Factored Loads - Service I: 1.0DC + 1.0EH + 1.0EV

Vertical Loads and Vertical Moments

Item	Load Factor γ	Vertical load, V (k/ft)	Factored vertical load, V_u (k/ft)	Arm about ⌒ Footing	Factored Moment
Coping	1.00	0.47	0.47	1.90	0.90
Stem	1.00	5.16	5.16	1.85	9.57
Stem Bottom	1.00	2.21	2.21	0.48	1.06
Concrete Footing	1.00	6.30	6.30	0.00	0.00
Vertical Soil top	1.00	6.80	6.80	-2.46	-16.72
Vertical Soil bot 1	1.00	1.77	1.77	-0.13	-0.22
Vertical Soil bot 2	1.00	10.28	10.28	-3.36	-34.58
Bridge Railing	1.00	0.09	0.09	1.90	0.17
P_{v1}	1.00	0.00	0.00	-6.00	0.00
P_{v2}	1.00	0.00	0.00	-6.00	0.00
P_{v3}	1.00	0.00	0.00	-6.00	0.00
P_{LSV}	1.00	0.00	0.00	-6.00	0.00
LS	1.00	1.77	1.77	-3.36	-5.96
TOTAL		34.85	34.85		-45.79

ΣM_v

Horizontal Loads and Horizontal Moments

Item	Load Factor γ	Horizontal load H (k/ft)	Factored horizontal load, H_u (k/ft)	Arm about ⌒ Footing	Factored Moment
P_{h1}	1.00	19.16	19.16	9.25	177.27
P_{h2}	1.00	0.00	0.00	0.00	0.00
P_{h3}	1.00	0.00	0.00	0.00	0.00
P_{LSH}	1.00	2.76	2.76	13.88	38.33
TOTAL		21.93	21.93		215.60

ΣM_H

LAMSON ENGINEERING CORPORATION				Final Page No.:	
Project: Bridge No. W-38-003, Wilmington		Job No.:		Preliminary Sheet No.:	
Subject: Wingwall - 10.75 Micropile		Prepared by: SL		Date: 12/2022	
Detail: Pile_SERVICE I		Checked by: JG/FL		Date: 12/2022	

Pile SERVICE I

Cross Section = 0.63 ft.²

Number of Pile, n = 21

Length to Expansion Joint = 23.2 ft

Factored Load at Bottom of Pile Cap Through Centroid of the Pile Group:

Factored Horizontal Resistance (Front Piles battered 1:4) = 163.53 x 7 ea / 4 = 286.2 kips

Vertical, F_z = 808.45 kips

F_y = 508.7 - 286.18 = 222.51 kips

F_x = 0.00 kips

M_x = (-45.79+215.6) k-ft/ft x 23.2 ft + 808.45 k x 0 ft
= 3939.63 k-ft

M_y = 0.00 kips-ft

Pile #	A _p (sf)	X _i (ft.)	Y _i (ft.)	A _p X _i (ft. ³)	A _p Y _i (ft. ³)	dx ² (X _i - X _{C.G.}) ²	dy ² (Y _i - Y _{C.G.}) ²	$\frac{M_x(Y_{C.G.} - Y_i)}{\sum (Y_i - Y_{C.G.})^2}$	$\frac{M_y(X_{C.G.} - X_i)}{\sum (X_i - X_{C.G.})^2}$	F _z / n	Σ F _z (kips)	Shear F _y / n	Shear F _x / n
1	0.63	0.00	-4.50	0.000	-2.836	101.434	20.250	62.53	0.00	38.498	101.03	10.60	0.00
2	0.63	3.00	-4.50	1.891	-2.836	50.005	20.250	62.53	0.00	38.498	101.03	10.60	0.00
3	0.63	6.50	-4.50	4.097	-2.836	12.755	20.250	62.53	0.00	38.498	101.03	10.60	0.00
4	0.63	10.00	-4.50	6.303	-2.836	0.005	20.250	62.53	0.00	38.498	101.03	10.60	0.00
5	0.63	13.50	-4.50	8.509	-2.836	11.755	20.250	62.53	0.00	38.498	101.03	10.60	0.00
6	0.63	17.00	-4.50	10.715	-2.836	48.005	20.250	62.53	0.00	38.498	101.03	10.60	0.00
7	0.63	20.50	-4.50	12.921	-2.836	108.755	20.250	62.53	0.00	38.498	101.03	10.60	0.00
1	0.63	0.00	0.00	0.000	0.000	101.434	0.000	0.00	0.00	38.498	38.50	10.60	0.00
2	0.63	3.00	0.00	1.891	0.000	50.005	0.000	0.00	0.00	38.498	38.50	10.60	0.00
3	0.63	6.50	0.00	4.097	0.000	12.755	0.000	0.00	0.00	38.498	38.50	10.60	0.00
4	0.63	10.00	0.00	6.303	0.000	0.005	0.000	0.00	0.00	38.498	38.50	10.60	0.00
5	0.63	13.50	0.00	8.509	0.000	11.755	0.000	0.00	0.00	38.498	38.50	10.60	0.00
6	0.63	17.00	0.00	10.715	0.000	48.005	0.000	0.00	0.00	38.498	38.50	10.60	0.00
7	0.63	20.50	0.00	12.921	0.000	108.755	0.000	0.00	0.00	38.498	38.50	10.60	0.00
1	0.63	0.00	4.50	0.000	2.836	101.434	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
2	0.63	3.00	4.50	1.891	2.836	50.005	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
3	0.63	6.50	4.50	4.097	2.836	12.755	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
4	0.63	10.00	4.50	6.303	2.836	0.005	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
5	0.63	13.50	4.50	8.509	2.836	11.755	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
6	0.63	17.00	4.50	10.715	2.836	48.005	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
7	0.63	20.50	4.50	12.921	2.836	108.755	20.250	-62.53	0.00	38.498	-24.04	10.60	0.00
21	13.24			133.31	0.00						101.03 -24.04	10.60 10.60	

$$X_{C.G.} = \sum A_p X_i / \sum A_p = 133.31 / 13.24 = 10.071 \text{ ft.} \quad Y_{C.G.} = \sum A_p Y_i / \sum A_p = 0.00 / 13.24 = 0.000 \text{ ft.}$$

$$\sum (X_i - X_{C.G.})^2 = 998 \text{ ft.}^2 \quad \sum (Y_i - Y_{C.G.})^2 = 283.50 \text{ ft.}^2$$

$$\text{Resultant Shear on Single Pile} = (10.60^2 + 0.00^2)^{0.5} = 10.60 \text{ kips}$$

LAMSON ENGINEERING CORPORATION		Final Page No:	
Project:	Bridge No. W-38-003, Wilmington	Job No:	Preliminary Sheet No:
Subject:	Wingwall Type 2A - 10.75 Dia. Micropile	Prepared by: SL	Date: 5/2023
Detail:	Summary of Micropile Resistance	Checked by: JG/FL	Date: 5/2023

Summary of Micropile Resistance - Wingwall Type 2A.

Steel Casing: 10.75 in. O.D. x 0.595 in., $F_y = 52$ ksi, Wall Thickness = 0.595 in.

Steel Reinforcing Bar: #14, Threaded, Grade 60

Compressive strength of micropile grout at 28 days: $f_c = 5$ ksi

Rock Socket Diameter = 9.56 in.

Estimated Bonded Length into Rock (Grout into intact bedrock) = 5.5 ft.

Plunge Length (Casing into Intact Bedrock) = 1 ft

Nominal Geotechnical Pile Resistance per Pile = 297.3 kips

Side Resistance Factor, ϕ_{stat} = 0.55

Factored Geotechnical Pile Resistance per Pile = 163.5 kips > 140 k OK

Nominal Uplift Resistance per Pile = 148.7 kips

Resistance Factor, ϕ_{up} = 0.55

Factored Uplift Resistance per Pile = 81.8 kips > 62.8 k OK

Nominal Structural Pile Resistance per Pile = 1096.9 k (Portion of Cased Length)

Nominal Structural Pile Resistance per Pile = 366.0 k (Portion of Uncased Length)

Compression Resistance Factor, ϕ_c = 0.75

Factored Structural Pile Resistance per Pile = 822.7 k (Portion of Cased Length)

Factored Structural Pile Resistance per Pile = 274.5 k (Portion of Uncased Length)

LAMSON ENGINEERING CORPORATION		Final Page No:	
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Detail:	Summary of Micropile Resistance	Checked by: JG/FL	Date: 5/2023

Nominal Tension Resistance = 995.0 k (Portion of Cased Length)

Nominal Tension Resistance = 135.1 k (Portion of Uncased Length)

Tension Resistance Factor, ϕ_T = 0.8

Factored Tension Resistance = 796.0 k (Portion of Cased Length)

Factored Tension Resistance = 108.1 k (Portion of Uncased Length)

LAMSON ENGINEERING CORPORATION		Final Page No:	
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Subject:	Wingwall Type 2A - 10.75 Dia. Micropile	Prepared by: SL	Date: 5/2023
Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

Axial Compression Resistance

Based on Boring BB-1 $O.D. = 10.75$ in. $t_{wall} = 0.595$ in.

$$R_R = \text{Factored Resistance of a micropile}$$

$$= \phi R_n = \phi_{qp} R_p + \phi_{qs} R_s$$

in which:

$$R_p = q_p A_p$$

$$R_s = q_s A_s$$

where:

$$R_p = \text{nominal tip resistance}$$

(Per AASHTO C10.9.3.5.1, tip resistance is neglected for conservative)

$$R_s = \text{nominal grout to ground bond resistance}$$

$$\phi_{qp} = \text{resistance factor for tip resistance}$$

$$= 0.50 \quad (\text{AASHTO 10.5.5.2.5-1})$$

Note: Tip resistance not included in the pile resistance calculation.

$$\phi_{qs} = \text{resistance factor for grout-to-ground resistance}$$

$$= 0.55 \quad (\text{AASHTO 10.5.5.2.5-1})$$

$$d_p = \text{diameter of micropile tip}$$

$$= 9.56 \text{ in.}$$

$$A_p = \text{area of micropile tip} = \pi D^2/4$$

$$= 71.78 \text{ in.}^2 = 0.50 \text{ ft}^2$$

$$R_s = \pi d_b \alpha_b L_b$$

in which:

$$d_b = \text{diameter of micropile drill hole through bonded length}$$

$$= 9.56 \text{ in.} = 0.80 \text{ ft}$$

$$\alpha_b = \text{nominal micropile grout-to-ground bond strength}$$

$$= 21.6 \text{ ksf for Type A Diorite}$$

(AASHTO Table C10.9.3.5.2 - 1)

LAMSON ENGINEERING CORPORATION			Final Page No:
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Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

$$L_b = \text{micropile bonded length}$$

$$= 5.5 \text{ ft into Intact Bedrock}$$

$$\phi_{qs} R_s = 0.55 \times 3.141 \times 0.8 \times [21.6 \times 5.5]$$

$$= 163.5 \text{ kips}$$

$$R_n = 163.53 / 0.55 = \underline{297 \text{ kips}}$$

$$R_R = \underline{164 \text{ kips}}$$

Uplift Resistance

$$\text{Uplift Resistance} = 50 \% \text{ of the compression resistance}$$

$$= 0.5 \times 163.5 = \underline{82 \text{ kips}}$$

$$\phi_{up} = \text{resistance factor}$$

$$= 0.55$$

$$\text{Nominal Resistance} = 81.8 / 0.55 = \underline{149 \text{ kips}}$$

Structural Resistance

Axial Compression Resistance

$$R_C = \text{Factored Structural Resistance of a micropile}$$

$$= \phi_c R_n$$

in which:

$$\phi_C = \text{resistance factor for tip resistance}$$

$$= 0.75 \quad (\text{AASHTO 10.5.5.2.5-2})$$

$$R_n = \text{Nominal axial compression resistance}$$

• For the cased length

$$F_y = 52 \text{ ksi}$$

$$f_y = 60 \text{ ksi} \quad (\text{Reinforcing Bar Grade 60})$$

LAMSON ENGINEERING CORPORATION			Final Page No:
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Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

$$R_n = 0.85 [0.85 f_c A_g + f_y (A_b + A'_c)]$$

where:

$$f_c = \text{specified compressive strength of micropile grout at 28 days}$$

$$= 5.0 \text{ ksi}$$

$$f_y = \text{specified minimum yield strength of reinforcement bar or steel casing, or stress in steel reinforcement bar or casing at a strain of 0.003, whichever is less}$$

$$\text{Min. } (F_y, f_y) = 52.0 \text{ ksi}$$

$$d_b = 1.69 \text{ in. } \#14 \text{ threaded bar}$$

$$A_b = \text{cross-section area of steel reinforcing bar}$$

$$= 2.25 \text{ in.}^2$$

$$A_c = \text{cross-section area of steel casing}$$

$$= 18.98 \text{ in.}^2$$

$$A'_c = \text{cross-section area of steel casing with 1/16" section loss on outside of the casing}$$

$$= 16.9 \text{ in.}^2 \quad \text{Section loss} = 0.063 \text{ in.}$$

$$A_g = \text{cross-section area of grout within micropile}$$

$$= A_{ID} - A_b = 71.78 - 2.25$$

$$= 69.53 \text{ in.}^2$$

$$R_n = 0.85 \times [0.85 \times 5 \times 69.53 + 52 \times (2.25 + 16.88)]$$

$$= 1096.9 \text{ kips}$$

$$R_{CC} = 0.75 \times 1096.9 = \underline{823 \text{ kips}}$$

• For the uncased length

$$R_n = 0.85 [0.85 f_c A_g + f_y A_b]$$

$$f_y = \text{specified minimum yield strength of reinforcement bar or stress in steel reinforcement bar at a strain of 0.003, whichever is less}$$

$$= 60.0 \text{ ksi}$$

$$= 60 \text{ ksi}$$

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Detail:	Micropile Vertical Resistance	Checked by: JG	Date: 5/2023

$$R_n = 0.85 \times [0.85 \times 5 \times 69.53 + 60 \times 2.25]$$

$$= 366.0 \text{ kips}$$

$$R_{CU} = 0.75 \times 366 = \underline{274 \text{ kips}}$$

Axial Tension Resistance

$$R_T = \text{factored Structural Resistance of a micropile}$$

$$= \phi_T R_n$$

in which:

$$\phi_T = \text{resistance factor for tip resistance}$$

$$= 0.80 \quad (\text{AASHTO 10.5.5.2.5-2})$$

$$R_n = \text{nominal axial tension resistance}$$

• For the cased length

$$R_n = f_y (A_b + A'_c)$$

$$= 52 \times (2.25 + 16.88) = 995.0 \text{ kips}$$

$$R_{TC} = 0.8 \times 995 = \underline{796 \text{ kips}}$$

• For the uncased length

$$R_n = f_y A_b$$

$$= 60 \times 2.25 = 135.1 \text{ kips}$$

$$R_{TU} = 0.8 \times 135.1 = \underline{108 \text{ kips}}$$

LAMSON ENGINEERING CORPORATION			Final Page No:	
Project:	Bridge No. W-38-003, Wilmington	Job No:	Preliminary Sheet No:	
Subject:	Wingwall Micropile Foundation	Prepared by: SL	Date:	5/2023
Detail:	Lpile Analysis	Checked by: JG	Date:	5/2023

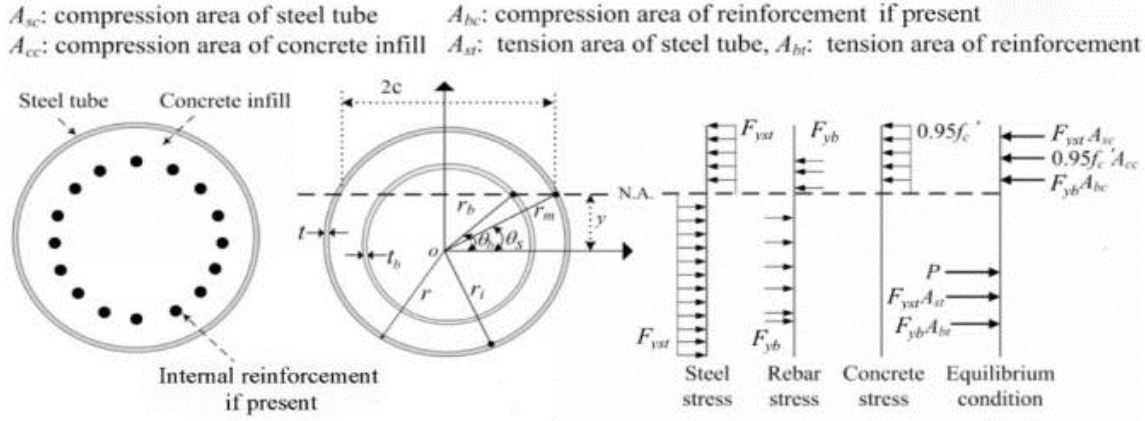


Figure C6.12.2.3.3-1—PSDM Model

$$\begin{aligned}
 P_n = & F_{yst} t r_m \left[(\pi - 2\theta_s) - (\pi + 2\theta_s) \right] \\
 & + t_b r_b \left[F_{yb} (\pi - 2\theta_b) - (F_{yb} - 0.95f'_c) (\pi + 2\theta_b) \right] \\
 & + \frac{0.95f'_c}{2} \left[(\pi - 2\theta_s) r_i^2 - 2yc \right]
 \end{aligned}
 \tag{C6.12.2.3.3-1}$$

$$\begin{aligned}
 M_n = & 0.95f'_c c \left[(r_i^2 - y^2) - \frac{c^2}{3} \right] + 4F_{yst} t c \frac{r_m^2}{r_i} + 4F_{yb} t_b c_b r_b \\
 & - 4F_{yb} t_b c_b r_b
 \end{aligned}
 \tag{C6.12.2.3.3-2}$$

in which:

$$r_m = r - \frac{t}{2}
 \tag{C6.12.2.3.3-3}$$

$$\theta_s = \sin^{-1} \left(\frac{y}{r_m} \right)
 \tag{C6.12.2.3.3-4}$$

$$\theta_b = \sin^{-1} \left(\frac{y}{r_b} \right)
 \tag{C6.12.2.3.3-5}$$

$$c = r_i \cos \theta_s
 \tag{C6.12.2.3.3-6}$$

$$c_b = r_b \cos \theta_b
 \tag{C6.12.2.3.3-7}$$

$$t_b = \frac{nA_b}{2\pi r_b}
 \tag{C6.12.2.3.3-8}$$

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Detail:	Lpile Analysis	Checked by:	JG	Date:	5/2023

Yield Strength, $F_{yst} = 52.00$ ksi
 Strength of Concrete, $f'_c = 5.00$ ksi
 Resistance factor for CFST in compression, $\phi_c = 0.90$ (AASHTO 6.5.4.2)
 Yield Strength, $F_{yb} = 60.00$ ksi
 (AASHTO 6.9.6.2 Limitations) $D/t = 20.0 < 0.15 E / F_{yst} = 83.7$ **OK**
 Concrete shall be greater than 3 ksi or $0.075 F_{yst} = 3.9$ ksi < 5.00 ksi **OK**

$A_s = 2.25$ in² Cover = 3.934 in.
 $r = 5.313$ in. $t = 0.5325$ in.
 $r_m = 5.046$ in.
 $r_i = 4.780$ in.
 $r_b = 0.000$ in. Internal reinforcement is not considered.
 Number of reinforcing bars, $n = 1.0$
 $t_b = n A_s / (2 \pi r_b) = 0$ in.

Strength I

Factored Moment = 109.2 k-ft from Lpile
 Factored Axial Load = 139.9 k from Lpile

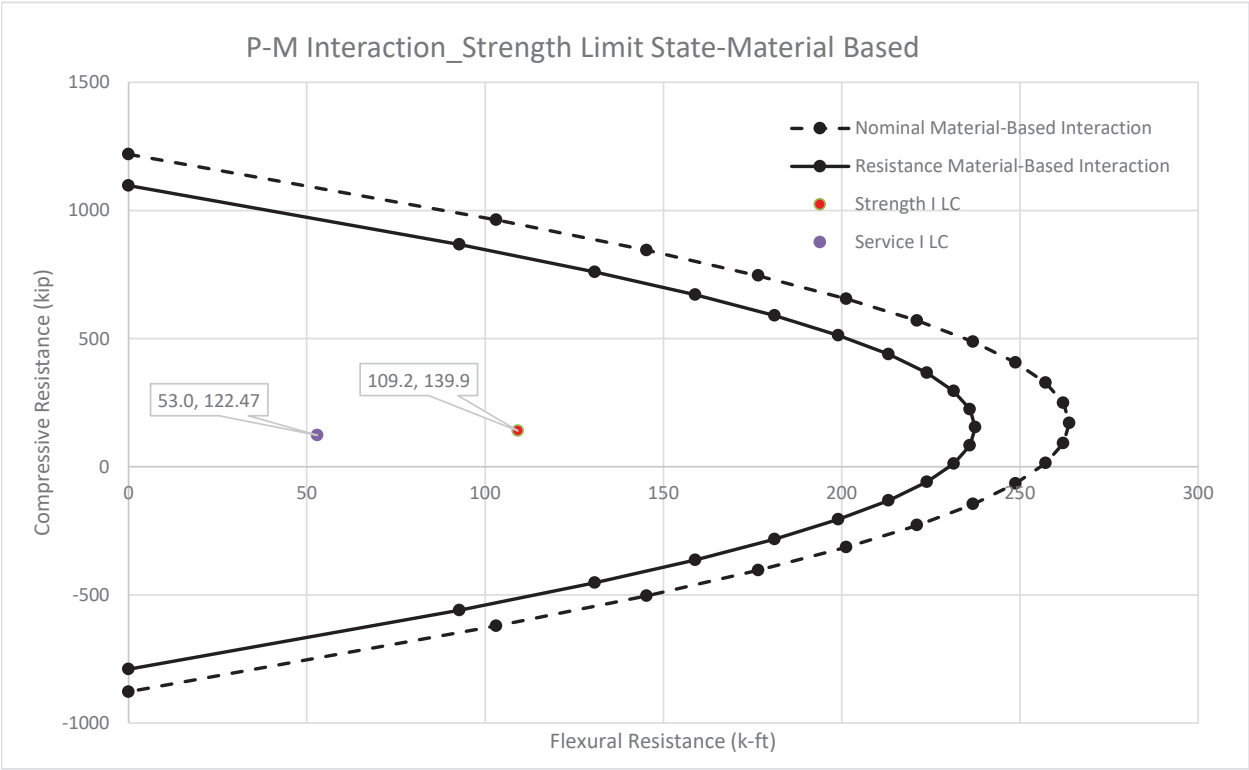
Service I

Factored Moment = 53.0 k-ft from Lpile
 Factored Axial Load = 122.47 k from Lpile

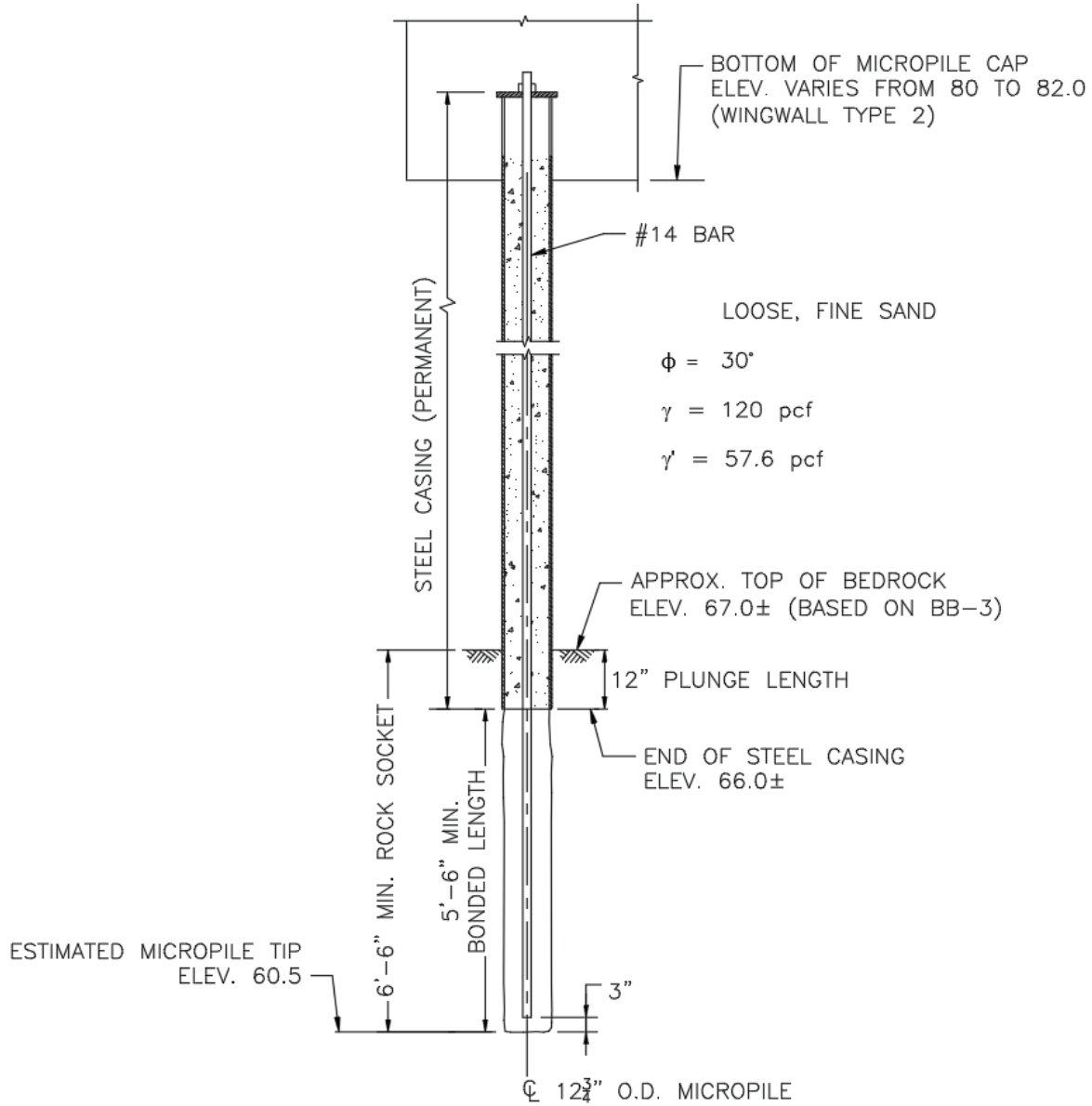
Composite Concrete-Filled Steel Tubes (CFSTs) (AASHTO LRFD 6.12.2.3.3)

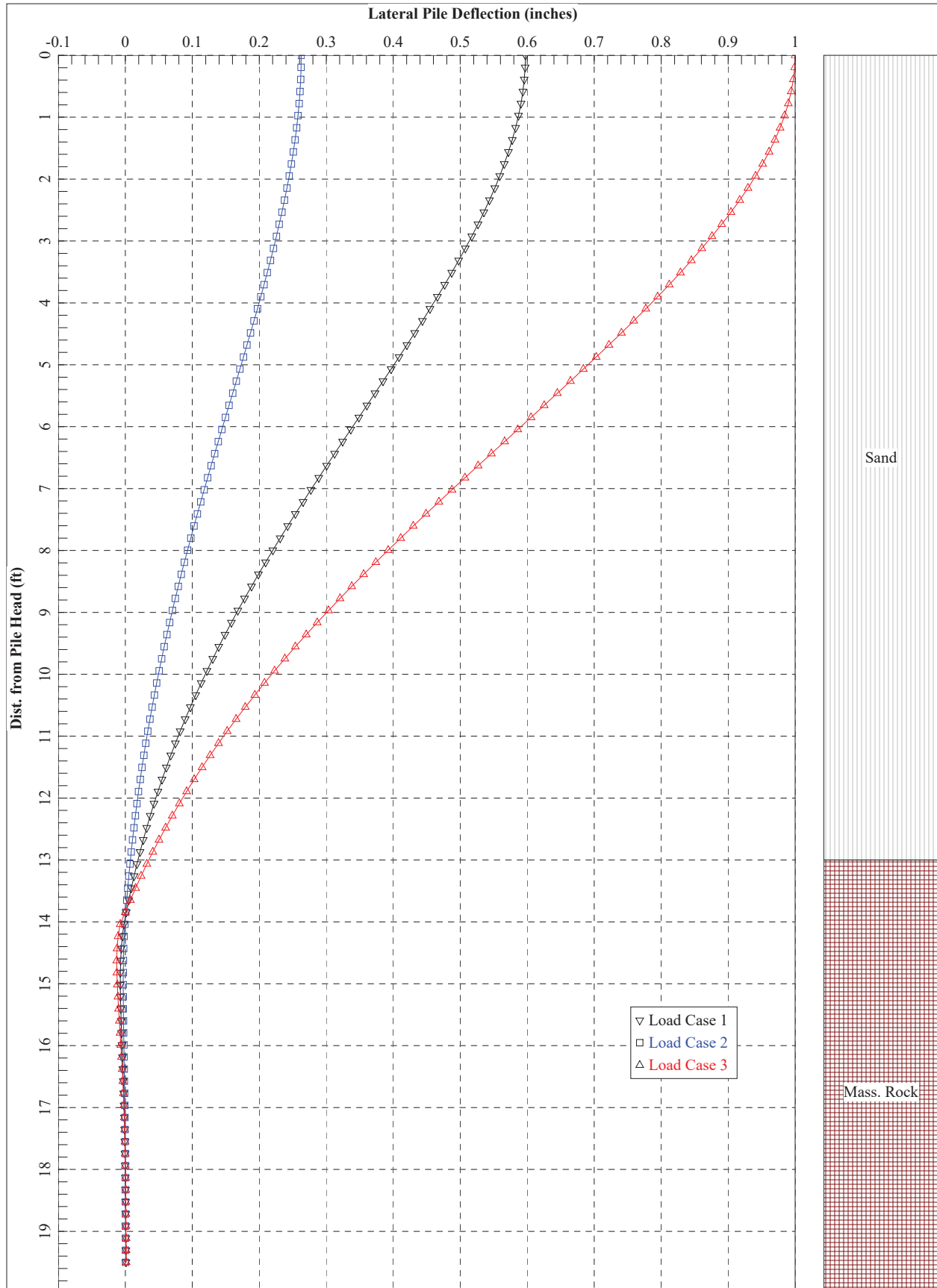
y (in.)	θ_s (rad)	θ_b (rad)	$c = r_i \cos \theta_b$	$c_b = r_b \cos \theta_b$	$\pi - 2 \theta_s$	$\pi + 2 \theta_s$	M_n (kips-ft)	P_n (kips)	$\phi_c M_n$ (kips-ft)	$\phi_c P_n$ (kips)
-5.05	-1.57	-1.57	0.00	0.00	6.28	0.00	0.00	1218.91	0.00	1097.02
-4.54	-1.12	-1.57	2.08	0.00	5.38	0.90	103.09	962.82	92.78	866.54
-4.04	-0.93	-1.57	2.87	0.00	5.00	1.29	145.35	844.40	130.81	759.96
-3.53	-0.78	-1.57	3.41	0.00	4.69	1.59	176.62	745.30	158.95	670.77
-3.03	-0.64	-1.57	3.82	0.00	4.43	1.85	201.36	654.98	181.23	589.48
-2.52	-0.52	-1.57	4.14	0.00	4.19	2.09	221.20	569.57	199.08	512.61
-2.02	-0.41	-1.57	4.38	0.00	3.96	2.32	236.88	487.15	213.19	438.44
-1.51	-0.30	-1.57	4.56	0.00	3.75	2.53	248.81	406.64	223.93	365.97
-1.01	-0.20	-1.57	4.68	0.00	3.54	2.74	257.20	327.33	231.48	294.59
-0.50	-0.10	-1.57	4.76	0.00	3.34	2.94	262.20	248.74	235.98	223.86
0.00	0.00	1.57	4.78	0.00	3.14	3.14	263.86	170.48	237.47	153.43
0.50	0.10	1.57	4.76	0.00	2.94	3.34	262.20	92.22	235.98	83.00
1.01	0.20	1.57	4.68	0.00	2.74	3.54	257.20	13.63	231.48	12.27
1.51	0.30	1.57	4.56	0.00	2.53	3.75	248.81	-65.68	223.93	-59.11
2.02	0.41	1.57	4.38	0.00	2.32	3.96	236.88	-146.19	213.19	-131.57
2.52	0.52	1.57	4.14	0.00	2.09	4.19	221.20	-228.61	199.08	-205.75
3.03	0.64	1.57	3.82	0.00	1.85	4.43	201.36	-314.02	181.23	-282.62
3.53	0.78	1.57	3.41	0.00	1.59	4.69	176.62	-404.34	158.95	-363.90
4.04	0.93	1.57	2.87	0.00	1.29	5.00	145.35	-503.44	130.81	-453.10
4.54	1.12	1.57	2.08	0.00	0.90	5.38	103.09	-621.86	92.78	-559.68
5.05	1.57	1.57	0.00	0.00	0.00	6.28	0.00	-877.95	0.00	-790.16

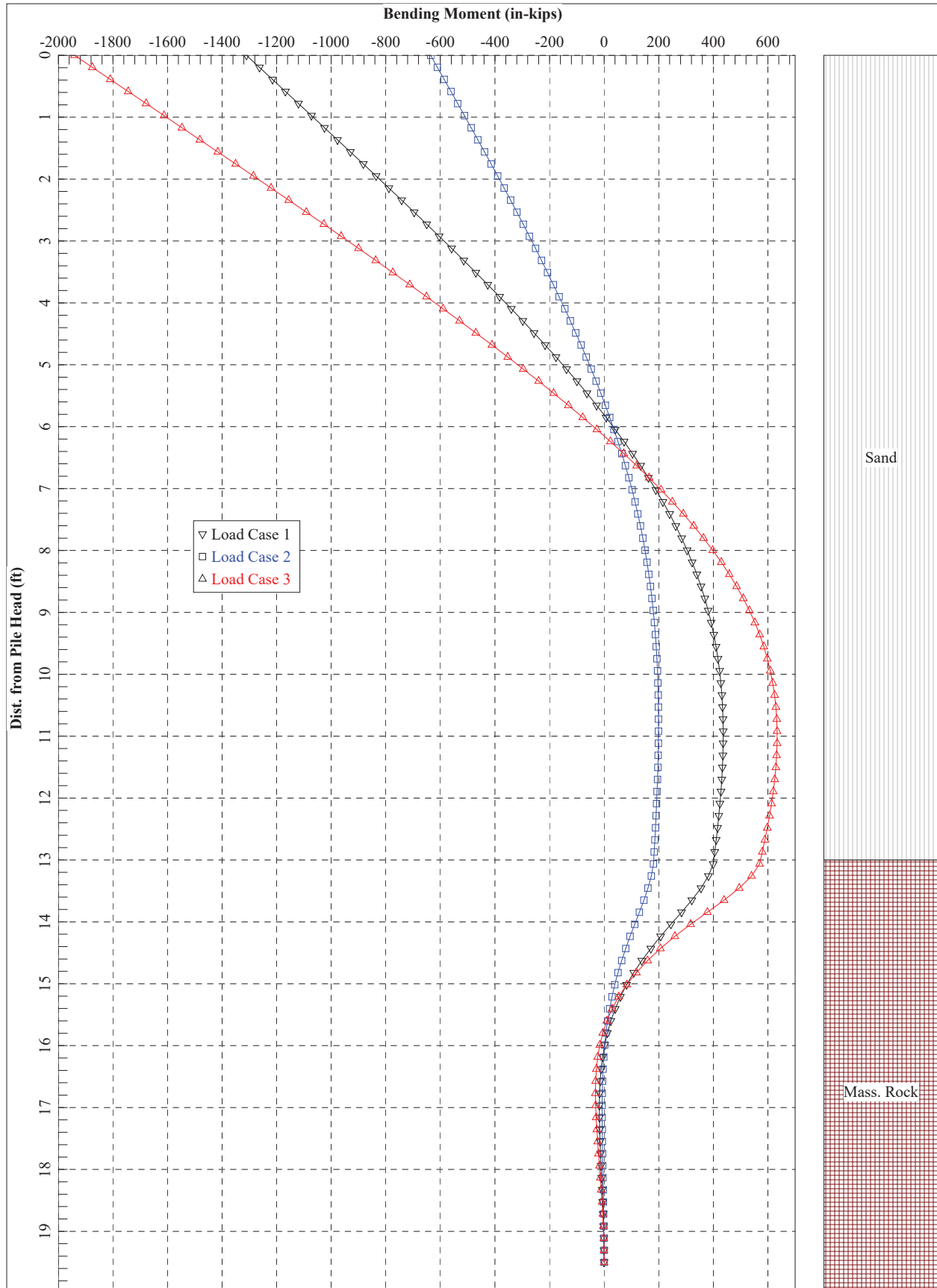
LAMSON ENGINEERING CORPORATION			Final Page No:	
Project:	Bridge No. W-38-003, Wilmington	Job No:	Preliminary Sheet No:	
Subject:	Wingwall Micropile Foundation	Prepared by:	SL	Date: 5/2023
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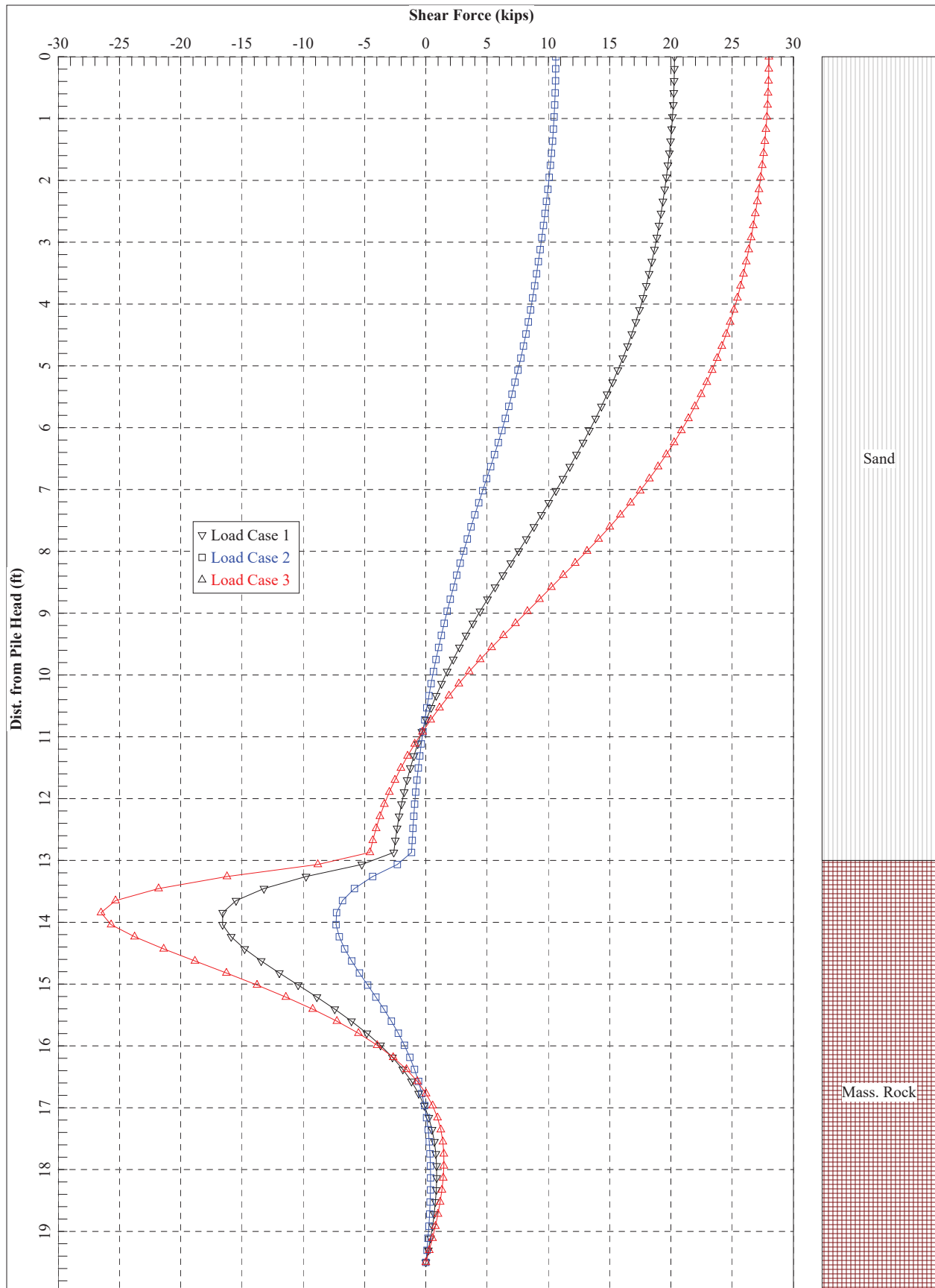


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Subject:	Wingwall Micropile Foundation	Prepared by: SL	Date: 12/2022
Detail:	Lpile Analysis	Checked by: JG	Date: 12/2022









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LPILE for Windows, Version 2022-12.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:
\\Users\Lamson Engineering\Desktop\Charlie's Lamson Files\Green\W-38-003 (2NV) - Wilmington\5.2 Geotech Report -
Bridge & Wingwall Rev\LPILE\

Name of input data file:
Wilmington W38003_Wingwall Type 2A Micropile.lp12d

Name of output report file:
Wilmington W38003_Wingwall Type 2A Micropile.lp12o

Name of plot output file:
Wilmington W38003_Wingwall Type 2A Micropile.lp12p

Name of runtime message file:
Wilmington W38003_Wingwall Type 2A Micropile.lp12r

Date and Time of Analysis

Date: December 15, 2022 Time: 12:27:55

Problem Title

Butters Row Bridge W-38-003, Wilmington

Job Number:

Client: MassDOT

Engineer: Lamson Engineering Corporation

Description: Wingwall Type 2A - 10.75 Dia. Micropile

Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 19.500 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	10.7500
2	14.000	10.7500
3	14.000	9.5600

4 19.500 9.5600

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with permanent casing
 Length of section = 14.000000 ft
 Casing outside diameter = 10.750000 in

Pile Section No. 2:

Section 2 is a round drilled shaft, bored pile, or CIDH pile
 Length of section = 5.500000 ft
 Shaft Diameter = 9.560000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians

 Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
 Distance from top of pile to bottom of layer = 13.000000 ft
 Effective unit weight at top of layer = 57.600000 pcf
 Effective unit weight at bottom of layer = 57.600000 pcf
 Friction angle at top of layer = 30.000000 deg.
 Friction angle at bottom of layer = 30.000000 deg.
 Subgrade k at top of layer = 20.000000 pci
 Subgrade k at bottom of layer = 20.000000 pci

Layer 2 is massive rock, p-y criteria by Liang et al., 2009

Distance from top of pile to top of layer = 13.000000 ft
 Distance from top of pile to bottom of layer = 20.500000 ft
 Effective unit weight at top of layer = 164.000000 pcf
 Effective unit weight at bottom of layer = 164.000000 pcf
 Uniaxial compressive strength at top of layer = 23836. psi
 Uniaxial compressive strength at bottom of layer = 23836. psi
 Poisson's ratio at top of layer = 0.090000
 Poisson's ratio at bottom of layer = 0.090000
 Option 1: Intact rock modulus at top of layer = 2480000. psi
 Intact rock modulus at bottom of layer = 2480000. psi
 Option 1: Geologic Strength Index for layer = 35.000000
 Option 2: Rock mass modulus at top of layer = 0.0000 psi
 Rock mass modulus at bottom of layer = 0.0000 psi
 Option 1 will be used to compute values of rock mass modulus for the p-y curve
 in massive rock.
 The rock type is (igneous) diorite, Hoek-Brown Material Constant $m_i = 25$

(Depth of the lowest soil layer extends 1.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 164.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Geologic Num. Strength Index	Soil Type Int. Rock Name Modulus (p-y Curve Type) psi	Hoek-Brown Material Index, mi	Layer Depth ft	Effective Unit Wt. Poisson's pcf Ratio	Angle of Friction deg.	Uniaxial qu psi	kpy pci	Rock Mass Modulus psi
1	Sand 0.00 (Reese, et al.) 0.00	0.00	0.00 0.00 13.0000 0.00	57.6000 0.00 57.6000 0.00	30.0000 30.0000	-- --	20.0000 20.0000	-- --
2	Massive 2480000. Rock 2480000.	25.0000	13.0000 0.09000 20.5000 0.09000	164.0000 0.09000 164.0000 0.09000	-- --	23836. 23836.	-- --	Internally Computed

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.7000	1.0000
2	13.000	0.7000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 3

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
-------------	--------------	----------------	----------------	----------------------------	----------------------------------	--------------

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1	2	V =	20290. lbs	S =	0.0000 in/in	137970.	Yes	Yes
2	2	V =	10600. lbs	S =	0.0000 in/in	99370.	Yes	Yes
3	5	y =	1.000000 in	S =	0.0000 in/in	99370.	N.A.	Yes

V = shear force applied normal to pile axis

M = bending moment applied to pile head

y = lateral deflection normal to pile axis

S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head

Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).

Thrust force is assumed to be acting axially for all pile batter angles.

----- Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness -----

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile) with Permanent Casing:

Length of Section	=	14.000000 ft
Outer Diameter of Casing	=	10.750000 in
Concrete Cover Thickness Inside Casing	=	3.655000 in
Casing Wall Thickness	=	0.595000 in
Moment of Inertia of Steel Casing	=	245.530255 in^4
Yield Stress of Casing	=	52000. psi
Elastic Modulus of Casing	=	29000000. psi
Number of Reinforcing Bars	=	1 bar
Area of Single Reinforcing Bar	=	2.250000 sq. in.
Edge-to-Edge Bar Spacing	=	-1.69300 in
Maximum Concrete Aggregate Size	=	0.375000 in
Ratio of Bar Spacing to Aggregate Size	=	-4.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Pile	=	90.762575 sq. in.
Area of Concrete	=	69.530366 sq. in.
Cross-sectional Area of Steel Casing	=	18.982210 sq. in.
Area of All Steel (Casing and Bars)	=	21.232210 sq. in.
Area Ratio of All Steel to Gross Area of Pile	=	23.39 percent

Axial Structural Capacities:

Nom. Axial Structural Capacity = $0.85 F_c A_c + F_y A_s$	=	1417.579 kips
Tensile Load for Cracking of Concrete	=	-103.016 kips
Nominal Axial Tensile Capacity	=	-1122.075 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
-----	-----	-----	-----	-----
1	1.693000	2.250000	0.00000	0.00000

NOTE: The positions of the above rebars were computed by LPile

Concrete Properties:

Compressive Strength of Concrete = 5000. psi
 Modulus of Elasticity of Concrete = 4030509. psi
 Modulus of Rupture of Concrete = -530.33009 psi
 Compression Strain at Peak Stress = 0.002109
 Tensile Strain at Fracture of Concrete = -0.0001150
 Maximum Coarse Aggregate Size = 0.375000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	99.370
2	137.970

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
 Y = stress in reinforcing steel has reached yield stress.
 T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
 Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
 Position of neutral axis is measured from edge of compression side of pile.
 Compressive stresses and strains are positive in sign.
 Tensile stresses and strains are negative in sign.

Axial Thrust Force = 99.370 kips

Bending Max Casing Run Curvature Stress Msg rad/in. ksi	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi
0.00000125	11.2227830	8978226.	90.2036499	0.0001128	0.00009932	0.5200623	3.1042651
3.2679339							
0.00000250	22.4443190	8977728.	47.7902483	0.0001195	0.00009260	0.5498778	3.1335586
3.4608961							
0.00000375	33.6658444	8977558.	33.6528610	0.0001262	0.00008589	0.5796006	3.1628971
3.6539033							
0.00000500	44.8873537	8977471.	26.5844773	0.0001329	0.00007917	0.6092308	3.1922805
3.8469555							
0.00000625	56.1088417	8977415.	22.3436950	0.0001396	0.00007246	0.6387681	3.2217088
4.0400525							
0.00000750	67.3303030	8977374.	19.5167134	0.0001464	0.00006575	0.6682126	3.2511821
4.2331946							
0.00000875	78.5517322	8977341.	17.4976179	0.0001531	0.00005904	0.6975642	3.2807003
4.4263815							
0.00001000	89.7731240	8977312.	15.9834512	0.0001598	0.00005233	0.7268229	3.3102634
4.6196134							
0.00001125	100.9944730	8977286.	14.8059038	0.0001666	0.00004563	0.7559884	3.3398715
4.8128902							
0.00001250	112.2157739	8977262.	13.8639898	0.0001733	0.00003892	0.7850608	3.3695245
5.0062120							
0.00001375	123.4370214	8977238.	13.0934456	0.0001800	0.00003222	0.8140401	3.3992224
5.1995787							

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0.00001500	134.6582100	8977214.	12.4514288	0.0001868	0.00002552	0.8429260	3.4289653
5.3929903							
0.00001625	145.8793344	8977190.	11.9082791	0.0001935	0.00001882	0.8717187	3.4587531
5.5864469							
0.00001750	157.1003896	8977165.	11.4428108	0.0002002	0.00001212	0.9004178	3.4885854
5.7799479							
0.00001875	168.3213696	8977140.	11.0394876	0.0002070	0.00000543	0.9290236	3.5184632
5.9734944							
0.00002000	179.5422694	8977113.	10.6866572	0.0002137	-0.00000127	0.9575358	3.5483859
6.1670859							
0.00002125	190.7630836	8977086.	10.3754093	0.0002205	-0.00000796	0.9859544	3.5783535
6.3607223							
0.00002250	201.9838057	8977058.	10.0988133	0.0002272	-0.00001465	1.0142793	3.6083664
6.5544039							
0.00002375	213.2043429	8977025.	9.8513971	0.0002340	-0.00002134	1.0425104	3.6384233
6.7481295							
0.00002500	224.4243114	8976972.	9.6287801	0.0002407	-0.00002803	1.0706472	3.6685219
6.9418969							
0.00002625	235.6432189	8976885.	9.4274149	0.0002475	-0.00003472	1.0986891	3.6986587
7.1357025							
0.00002750	246.8605952	8976749.	9.2443991	0.0002542	-0.00004140	1.1266356	3.7288303
7.3295428							
0.00002875	258.0760181	8976557.	9.0773355	0.0002610	-0.00004809	1.1544862	3.7590332
7.5234145							
0.00003000	269.2891208	8976304.	8.9242264	0.0002677	-0.00005477	1.1822403	3.7892646
7.7173146							
0.00003125	280.4995887	8975987.	8.7833944	0.0002745	-0.00006146	1.2098975	3.8195216
7.9112403							
0.00003250	291.7071563	8975605.	8.6534203	0.0002812	-0.00006814	1.2374576	3.8498019
8.1051894							
0.00003375	302.9115923	8975158.	8.5330956	0.0002880	-0.00007482	1.2649200	3.8801034
8.2991596							
0.00003500	314.1127009	8974649.	8.4213845	0.0002947	-0.00008150	1.2922846	3.9104241
8.4931491							
0.00003625	325.3103159	8974078.	8.3173943	0.0003015	-0.00008818	1.3195510	3.9407624
8.6871561							
0.00003750	336.5042939	8973448.	8.2203515	0.0003083	-0.00009486	1.3467190	3.9711168
8.8811793							
0.00003875	347.6945122	8972762.	8.1295828	0.0003150	-0.000102	1.3737884	4.0014860
9.0752172							
0.00004000	358.8808677	8972022.	8.0444988	0.0003218	-0.000108	1.4007591	4.0318688
9.2692688							
0.00004125	370.0632693	8971231.	7.9645820	0.0003285	-0.000115	1.4276309	4.0622641
9.4633329							
0.00004250	371.5578520	8742538.	7.8240324	0.0003325	-0.000124	1.4433059	4.0121357
9.5768732 C							
0.00004375	381.7339111	8725347.	7.7478325	0.0003390	-0.000131	1.4687718	4.0334611
9.7618673 C							
0.00004500	391.8889995	8708644.	7.6756944	0.0003454	-0.000138	1.4941156	4.0545626
9.9466376 C							
0.00004625	402.0132680	8692179.	7.6071849	0.0003518	-0.000145	1.5193186	4.0753010
10.1310447 C							
0.00004750	412.1176167	8676160.	7.5421149	0.0003583	-0.000152	1.5443995	4.0958102
10.3152227 C							
0.00004875	422.2064415	8660645.	7.4802627	0.0003647	-0.000159	1.5693670	4.1161513
10.4992325 C							
0.00005125	442.3234920	8630702.	7.3651144	0.0003775	-0.000173	1.6189312	4.1560967
10.8665155 C							
0.00005375	462.3741389	8602310.	7.2601559	0.0003902	-0.000188	1.6680263	4.1952291
11.2329854 C							
0.00005625	482.3676684	8575425.	7.1640890	0.0004030	-0.000202	1.7166677	4.2336469
11.5987406 C							
0.00005875	502.3128496	8550006.	7.0758401	0.0004157	-0.000216	1.7648711	4.2714549
11.9638862 C							
0.00006125	522.2178543	8526006.	6.9945145	0.0004284	-0.000230	1.8126531	4.3087644
12.3285331 C							
0.00006375	542.0901835	8503375.	6.9193610	0.0004411	-0.000244	1.8600301	4.3456923
12.6927985 C							
0.00006625	561.9239224	8481871.	6.8496122	0.0004538	-0.000258	1.9069863	4.3821066

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13.0565504 C							
0.00006875	581.7277575	8461495.	6.7847466	0.0004665	-0.000273	1.9535406	4.4181435
13.4199247 C							
0.00007125	601.5122487	8442277.	6.7243527	0.0004791	-0.000287	1.9997208	4.4540143
13.7831331 C							
0.00007375	621.2609847	8423878.	6.6678030	0.0004918	-0.000301	2.0454811	4.4893497
14.1458060 C							
0.00007625	640.9999355	8406557.	6.6149708	0.0005044	-0.000315	2.0908923	4.5247061
14.5084998 C							
0.00007875	660.7057026	8389914.	6.5652647	0.0005170	-0.000330	2.1358872	4.5595406
14.8706718 C							
0.00008125	680.4026990	8374187.	6.5186337	0.0005296	-0.000344	2.1805362	4.5944136
15.2328824 C							
0.00008375	700.0762361	8359119.	6.4746514	0.0005423	-0.000358	2.2247944	4.6289582
15.5947645 C							
0.00008625	719.7347219	8344750.	6.4331703	0.0005549	-0.000372	2.2686878	4.6633815
15.9565252 C							
0.00008875	739.3852594	8331102.	6.3940464	0.0005675	-0.000387	2.3122376	4.6978569
16.3183381 C							
0.00009125	759.0085164	8317902.	6.3568901	0.0005801	-0.000401	2.3553820	4.7318659
16.6796847 C							
0.00009375	778.6250882	8305334.	6.3217467	0.0005927	-0.000415	2.3981873	4.7659601
17.0411164 C							
0.00009625	798.2348040	8293349.	6.2884578	0.0006053	-0.000429	2.4406528	4.8001352
17.4026290 C							
0.00009875	817.8192513	8281714.	6.2566946	0.0006178	-0.000444	2.4827157	4.8338517
17.7636830 C							
0.0001013	837.3970191	8270588.	6.2265289	0.0006304	-0.000458	2.5244398	4.8676535
18.1248223 C							
0.0001038	856.9680938	8259933.	6.1978451	0.0006430	-0.000472	2.5658250	4.9015401
18.4860463 C							
0.0001063	876.5264822	8249661.	6.1704762	0.0006556	-0.000487	2.6068492	4.9353192
18.8471630 C							
0.0001088	896.0691061	8239716.	6.1443004	0.0006682	-0.000501	2.6475013	4.9688898
19.2080710 C							
0.0001113	915.6050637	8230158.	6.1193272	0.0006808	-0.000515	2.6878149	5.0025476
19.5690664 C							
0.0001138	935.1343215	8220961.	6.0954773	0.0006934	-0.000529	2.7277895	5.0362901
19.9301464 C							
0.0001163	954.6563242	8212097.	6.0726725	0.0007059	-0.000544	2.7674227	5.0700991
20.2912928 C							
0.0001188	974.1604084	8203456.	6.0507367	0.0007185	-0.000558	2.8066728	5.1035903
20.6521215 C							
0.0001213	993.6578105	8195116.	6.0297295	0.0007311	-0.000572	2.8455840	5.1371679
21.0130366 C							
0.0001238	1013.	8187059.	6.0095946	0.0007437	-0.000587	2.8841561	5.1708301
21.3740364 C							
0.0001263	1033.	8179267.	5.9902803	0.0007563	-0.000601	2.9223886	5.2045771
21.7351209 C							
0.0001288	1052.	8171726.	5.9717389	0.0007689	-0.000615	2.9602815	5.2384090
22.0962903 C							
0.0001313	1072.	8164373.	5.9538588	0.0007814	-0.000629	2.9978079	5.2720698
22.4572885 C							
0.0001338	1091.	8157223.	5.9366402	0.0007940	-0.000644	3.0349831	5.3057036
22.8182598 C							
0.0001363	1110.	8150286.	5.9200750	0.0008066	-0.000658	3.0718185	5.3394223
23.1793160 C							
0.0001388	1130.	8143551.	5.9041278	0.0008192	-0.000672	3.1083140	5.3732261
23.5404573 C							
0.0001413	1149.	8137006.	5.8887659	0.0008318	-0.000687	3.1444693	5.4071150
23.9016838 C							
0.0001438	1169.	8130642.	5.8739589	0.0008444	-0.000701	3.1802842	5.4410893
24.2629955 C							
0.0001463	1188.	8124450.	5.8596781	0.0008570	-0.000715	3.2157583	5.4751489
24.6243926 C							
0.0001488	1208.	8118376.	5.8458278	0.0008696	-0.000729	3.2508626	5.5089944
24.9855756 C							
0.0001588	1285.	8095557.	5.7949563	0.0009199	-0.000787	3.3878635	5.6451472
26.4310785 C							

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0.0001688	1363.	8074798.	5.7503903	0.0009704	-0.000844	3.5193985	5.7826525
27.8779337 C							
0.0001788	1440.	8055640.	5.7108692	0.0010208	-0.000901	3.6453626	5.9204610
29.3250923 C							
0.0001888	1517.	8037934.	5.6757897	0.0010713	-0.000958	3.7658404	6.0596588
30.7736401 C							
0.0001988	1594.	8021458.	5.6444824	0.0011218	-0.001015	3.8808164	6.2002532
32.2235845 C							
0.0002088	1671.	8005967.	5.6162589	0.0011724	-0.001072	3.9902092	6.3413577
33.6740389 C							
0.0002188	1748.	7991387.	5.5908351	0.0012230	-0.001129	4.0940742	6.4838528
35.1258840 C							
0.0002288	1825.	7977596.	5.5678483	0.0012736	-0.001185	4.1923971	6.6277690
36.5791503 C							
0.0002388	1902.	7964493.	5.5469935	0.0013243	-0.001242	4.2851620	6.7731142
38.0338454 C							
0.0002488	1978.	7951978.	5.5279699	0.0013751	-0.001299	4.3723338	6.9195734
39.4896547 C							
0.0002588	2054.	7939977.	5.5105561	0.0014259	-0.001356	4.4538958	7.0670782
40.9465095 C							
0.0002688	2131.	7928450.	5.4946251	0.0014767	-0.001412	4.5298565	7.2160396
42.4048208 C							
0.0002788	2207.	7917342.	5.4800183	0.0015276	-0.001469	4.6001992	7.3664658
43.8645970 C							
0.0002888	2283.	7906609.	5.4665991	0.0015785	-0.001526	4.6649072	7.5183651
45.3258464 C							
0.0002988	2359.	7896210.	5.4542494	0.0016295	-0.001582	4.7239633	7.6717461
46.7885774 C							
0.0003088	2435.	7886112.	5.4428660	0.0016805	-0.001639	4.7773507	7.8266173
48.2527985 C							
0.0003188	2511.	7876285.	5.4323591	0.0017316	-0.001695	4.8250520	7.9829872
49.7185184 C							
0.0003288	2586.	7866693.	5.4226157	0.0017827	-0.001751	4.8670412	8.1405429
51.1854242 C							
0.0003388	2661.	7855808.	5.4139955	0.0018340	-0.001808	4.9033999	8.3034814
52.0000000 CY							
0.0003488	2732.	7833715.	5.4063092	0.0018855	-0.001864	4.9340468	8.4708658
52.0000000 CY							
0.0003588	2796.	7792902.	5.3994594	0.0019371	-0.001920	4.9589264	8.6424939
52.0000000 CY							
0.0003688	2851.	7732707.	5.3927098	0.0019886	-0.001976	4.9779106	8.8112209
52.0000000 CY							
0.0003788	2899.	7653451.	5.3854669	0.0020397	-0.002032	4.9909892	8.9706149
52.0000000 CY							
0.0003888	2940.	7561665.	5.3780789	0.0020907	-0.002088	4.9982828	9.1241699
52.0000000 CY							
0.0003988	2976.	7462888.	5.3707294	0.0021416	-0.002145	4.9988749	-9.372663
52.0000000 CY							
0.0004088	3008.	7359895.	5.3634747	0.0021923	-0.002202	4.9992137	-9.693703
52.0000000 CY							
0.0004188	3038.	7254480.	5.3563387	0.0022430	-0.002259	4.9993790	-10.017515
52.0000000 CY							
0.0004288	3065.	7147912.	5.3493317	0.0022935	-0.002316	4.9994158	-10.343863
52.0000000 CY							
0.0004388	3089.	7041124.	5.3424570	0.0023440	-0.002373	4.9993349	-10.672591
52.0000000 CY							
0.0004488	3112.	6934726.	5.3357641	0.0023944	-0.002430	4.9991152	-11.002941
52.0000000 CY							
0.0004588	3133.	6828850.	5.3294977	0.0024449	-0.002487	4.9987099	-11.331498
52.0000000 CY							
0.0004688	3152.	6724375.	5.3234040	0.0024953	-0.002544	4.9980273	-11.661343
52.0000000 CY							
0.0004788	3170.	6621616.	5.3174411	0.0025457	-0.002601	4.9999995	-11.992905
52.0000000 CY							
0.0004888	3187.	6520289.	5.3118639	0.0025962	-0.002658	4.9998414	-12.322460
52.0000000 CY							
0.0004988	3202.	6420418.	5.3063386	0.0026465	-0.002715	4.9992780	-12.654498
52.0000000 CY							
0.0005088	3217.	6322873.	5.3009393	0.0026969	-0.002772	4.9981098	-12.987882

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52.0000000 CY							
0.0005188	3230.	6227074.	5.2961879	0.0027474	-0.002829	4.9999910	-13.314652
52.0000000 CY							
0.0005288	3243.	6133237.	5.2912641	0.0027978	-0.002886	4.9994722	-13.646821
52.0000000 CY							
0.0005388	3255.	6041384.	5.2867129	0.0028482	-0.002943	4.9979637	-13.976023
52.0000000 CY							
0.0005488	3266.	5951832.	5.2824625	0.0028988	-0.003000	4.9999520	-14.303079
52.0000000 CY							
0.0006088	3321.	5454887.	5.2600602	0.0032021	-0.003342	4.9969526	-16.262454
52.0000000 CY							
0.0006688	3360.	5023689.	5.2436739	0.0035067	-0.003682	4.9999813	-18.183115
52.0000000 CY							
0.0007288	3388.	4649437.	5.2317574	0.0038126	-0.004021	4.9960951	-20.066336
52.0000000 CY							

Axial Thrust Force = 137.970 kips

Bending Max Casing Run Curvature Stress rad/in. ksi	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi
0.00000125	11.1752563	8940205.	123.5659919	0.0001545	0.0001410	0.7052867	4.3136500
4.4773188							
0.00000250	22.3487738	8939510.	64.4714258	0.0001612	0.0001343	0.7344784	4.3429440
4.6702815							
0.00000375	33.5222806	8939275.	44.7736533	0.0001679	0.0001276	0.7635773	4.3722832
4.8632895							
0.00000500	44.6957713	8939154.	34.9250791	0.0001746	0.0001209	0.7925834	4.4016677
5.0563427							
0.00000625	55.8692404	8939078.	29.0161843	0.0001814	0.0001142	0.8214966	4.4310975
5.2494412							
0.00000750	67.0426827	8939024.	25.0771291	0.0001881	0.0001075	0.8503169	4.4605725
5.4425850							
0.00000875	78.2160927	8938982.	22.2636967	0.0001948	0.0001007	0.8790441	4.4900927
5.6357740							
0.00001000	89.3894650	8938947.	20.1537784	0.0002015	0.00009404	0.9076783	4.5196583
5.8290083							
0.00001125	100.5627942	8938915.	18.5128695	0.0002083	0.00008733	0.9362193	4.5492690
6.0222878							
0.00001250	111.7360750	8938886.	17.2002673	0.0002150	0.00008063	0.9646671	4.5789250
6.2156125							
0.00001375	122.9093020	8938858.	16.1264335	0.0002217	0.00007393	0.9930216	4.6086263
6.4089826							
0.00001500	134.0824696	8938831.	15.2316760	0.0002285	0.00006723	1.0212827	4.6383729
6.6023979							
0.00001625	145.2555727	8938804.	14.4746696	0.0002352	0.00006053	1.0494504	4.6681647
6.7958584							
0.00001750	156.4286057	8938777.	13.8258961	0.0002420	0.00005383	1.0775246	4.6980017
6.9893642							
0.00001875	167.6015634	8938750.	13.2637090	0.0002487	0.00004713	1.1055052	4.7278840
7.1829153							
0.00002000	178.7744402	8938722.	12.7718733	0.0002554	0.00004044	1.1333921	4.7578116
7.3765116							
0.00002125	189.9472308	8938693.	12.3379741	0.0002622	0.00003374	1.1611854	4.7877844
7.5701532							
0.00002250	201.1199298	8938664.	11.9523553	0.0002689	0.00002705	1.1888848	4.8178025
7.7638400							
0.00002375	212.2925319	8938633.	11.6073936	0.0002757	0.00002036	1.2164904	4.8478658
7.9575721							
0.00002500	223.4650316	8938601.	11.2969905	0.0002824	0.00001367	1.2440021	4.8779744
8.1513494							
0.00002625	234.6374235	8938569.	11.0162091	0.0002892	0.00000699	1.2714197	4.9081283
8.3451721							

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0.00002750	245.8097022	8938535.	10.7610100	0.0002959	3.02776E-07	1.2987433	4.9383274
8.5390399							
0.00002875	256.9818625	8938500.	10.5280565	0.0003027	-0.00000638	1.3259727	4.9685718
8.7329531							
0.00003000	268.1538987	8938463.	10.3145677	0.0003094	-0.00001306	1.3531080	4.9988615
8.9269115							
0.00003125	279.3258049	8938426.	10.1182080	0.0003162	-0.00001974	1.3801489	5.0291964
9.1209152							
0.00003250	290.4975219	8938385.	9.9370006	0.0003230	-0.00002642	1.4070955	5.0595762
9.3149637							
0.00003375	301.6688009	8938335.	9.7692600	0.0003297	-0.00003310	1.4339473	5.0899993
9.5090555							
0.00003500	312.8393021	8938266.	9.6135412	0.0003365	-0.00003978	1.4607041	5.1204632
9.7031882							
0.00003625	324.0086681	8938170.	9.4685981	0.0003432	-0.00004645	1.4873653	5.1509654
9.8973591							
0.00003750	335.1765601	8938042.	9.3333506	0.0003500	-0.00005312	1.5139307	5.1815033
10.0915658							
0.00003875	346.3426671	8937875.	9.2068585	0.0003568	-0.00005980	1.5403997	5.2120745
10.2858057							
0.00004000	357.5067035	8937668.	9.0882988	0.0003635	-0.00006647	1.5667720	5.2426767
10.4800767							
0.00004125	368.6684110	8937416.	8.9769487	0.0003703	-0.00007314	1.5930474	5.2733078
10.6743766							
0.00004250	379.8275585	8937119.	8.8721704	0.0003771	-0.00007981	1.6192254	5.3039658
10.8687033							
0.00004375	390.9839406	8936776.	8.7733993	0.0003838	-0.00008648	1.6453058	5.3346489
11.0630551							
0.00004500	402.1373748	8936386.	8.6801333	0.0003906	-0.00009314	1.6712884	5.3653553
11.2574303							
0.00004625	413.2876986	8935950.	8.5919251	0.0003974	-0.00009981	1.6971728	5.3960837
11.4518275							
0.00004750	424.4347658	8935469.	8.5083743	0.0004041	-0.000106	1.7229590	5.4268326
11.6462451							
0.00004875	435.5784424	8934942.	8.4291217	0.0004109	-0.000113	1.7486466	5.4576006
11.8406819							
0.00005125	450.3391218	8787105.	8.2416743	0.0004224	-0.000129	1.7918319	5.4588839
12.1693027 C							
0.00005375	470.8960562	8760857.	8.1008612	0.0004354	-0.000142	1.8406465	5.5056784
12.5434347 C							
0.00005625	491.3377739	8734894.	7.9718634	0.0004484	-0.000156	1.8889393	5.5513289
12.9164227 C							
0.00005875	511.6850692	8709533.	7.8532835	0.0004614	-0.000170	1.9367379	5.5960241
13.2884553 C							
0.00006125	531.9478397	8684863.	7.7438889	0.0004743	-0.000184	1.9840549	5.6398406
13.6596093 C							
0.00006375	552.1357926	8660954.	7.6426445	0.0004872	-0.000198	2.0309035	5.6828626
14.0299688 C							
0.00006625	572.2583399	8637862.	7.5486752	0.0005001	-0.000212	2.0772975	5.7251815
14.3996252 C							
0.00006875	592.3245020	8615629.	7.4612366	0.0005130	-0.000226	2.1232512	5.7668954
14.7686767 C							
0.00007125	612.3316055	8594128.	7.3796079	0.0005258	-0.000240	2.1687578	5.8079354
15.1370541 C							
0.00007375	632.2880249	8573397.	7.3032406	0.0005386	-0.000254	2.2138303	5.8483920
15.5048482 C							
0.00007625	652.2087160	8553557.	7.2317152	0.0005514	-0.000268	2.2584968	5.8884819
15.8722757 C							
0.00007875	672.0894669	8534469.	7.1645361	0.0005642	-0.000282	2.3027490	5.9281267
16.2392580 C							
0.00008125	691.9280162	8516037.	7.1012729	0.0005770	-0.000296	2.3465798	5.9672574
16.6057262 C							
0.00008375	711.7483255	8498487.	7.0417444	0.0005897	-0.000311	2.3900394	6.0062853
16.9720916 C							
0.00008625	731.5193138	8481383.	6.9853949	0.0006025	-0.000325	2.4330606	6.0446334
17.3377772 C							
0.00008875	751.2820257	8465150.	6.9322453	0.0006152	-0.000339	2.4757317	6.0830463
17.7035275 C							
0.00009125	771.0001070	8449316.	6.8817671	0.0006280	-0.000353	2.5179718	6.1208218

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18.0686405 C							
0.00009375	790.7113843	8434255.	6.8340149	0.0006407	-0.000367	2.5598660	6.1586891
18.4338454 C							
0.00009625	810.3866293	8419601.	6.7885611	0.0006534	-0.000381	2.6013460	6.1960480
18.7985418 C							
0.00009875	830.0491595	8405561.	6.7453982	0.0006661	-0.000395	2.6424669	6.2333764
19.1632077 C							
0.0001013	849.6936930	8392036.	6.7043141	0.0006788	-0.000410	2.6832152	6.2705504
19.5277192 C							
0.0001038	869.3111797	8378903.	6.6650924	0.0006915	-0.000424	2.7235692	6.3073706
19.8918768 C							
0.0001063	888.9218292	8366323.	6.6277455	0.0007042	-0.000438	2.7635785	6.3442803
20.2561241 C							
0.0001088	908.5105574	8354120.	6.5920315	0.0007169	-0.000452	2.8032042	6.3809244
20.6201056 C							
0.0001113	928.0797312	8342290.	6.5578573	0.0007296	-0.000466	2.8424531	6.4173578
20.9838765 C							
0.0001138	947.6420566	8330919.	6.5252121	0.0007422	-0.000481	2.8813577	6.4538798
21.3477361 C							
0.0001163	967.1898031	8319912.	6.4939392	0.0007549	-0.000495	2.9198970	6.4902943
21.7114881 C							
0.0001188	986.7140766	8309171.	6.4638859	0.0007676	-0.000509	2.9580476	6.5263745
22.0749057 C							
0.0001213	1006.	8298816.	6.4350969	0.0007803	-0.000523	2.9958542	6.5625426
22.4384113 C							
0.0001238	1026.	8288825.	6.4074957	0.0007929	-0.000537	3.0333165	6.5987988
22.8020051 C							
0.0001263	1045.	8279077.	6.3809194	0.0008056	-0.000552	3.0704001	6.6348057
23.1653494 C							
0.0001288	1065.	8269587.	6.3553334	0.0008182	-0.000566	3.1071150	6.6706561
23.5285373 C							
0.0001313	1084.	8260405.	6.3307451	0.0008309	-0.000580	3.1434860	6.7065941
23.8918128 C							
0.0001338	1104.	8251516.	6.3070985	0.0008436	-0.000594	3.1795127	6.7426197
24.2551760 C							
0.0001363	1123.	8242876.	6.2843150	0.0008562	-0.000608	3.2151847	6.7786265
24.6185202 C							
0.0001388	1143.	8234394.	6.2622659	0.0008689	-0.000623	3.2504700	6.8142851
24.9815163 C							
0.0001413	1162.	8226164.	6.2410187	0.0008815	-0.000637	3.2854114	6.8500309
25.3445997 C							
0.0001438	1181.	8218172.	6.2205314	0.0008942	-0.000651	3.3200086	6.8858642
25.7077705 C							
0.0001463	1201.	8210406.	6.2007652	0.0009069	-0.000665	3.3542614	6.9217850
26.0710288 C							
0.0001488	1220.	8202855.	6.1816838	0.0009195	-0.000680	3.3881696	6.9577934
26.4343747 C							
0.0001588	1298.	8174236.	6.1111457	0.0009701	-0.000736	3.5201813	7.1008011
27.8867323 C							
0.0001688	1375.	8148244.	6.0491135	0.0010208	-0.000793	3.6466147	7.2445267
29.3398079 C							
0.0001788	1452.	8124396.	5.9941058	0.0010714	-0.000850	3.7674384	7.3886867
30.7933179 C							
0.0001888	1529.	8102404.	5.9450676	0.0011221	-0.000907	3.8826734	7.5336178
32.2475990 C							
0.0001988	1606.	8081970.	5.9010712	0.0011728	-0.000964	3.9922993	7.6791657
33.7024969 C							
0.0002088	1683.	8062957.	5.8615249	0.0012236	-0.001020	4.0963649	7.8261362
35.1588175 C							
0.0002188	1760.	8045062.	5.8256384	0.0012744	-0.001077	4.1947786	7.9733860
36.6154172 C							
0.0002288	1836.	8028231.	5.7930922	0.0013252	-0.001134	4.2876029	8.1219803
38.0733615 C							
0.0002388	1913.	8012335.	5.7634810	0.0013760	-0.001191	4.3748279	8.2720190
39.5327503 C							
0.0002488	1989.	7997220.	5.7363707	0.0014269	-0.001247	4.4564054	8.4229240
40.9930053 C							
0.0002588	2066.	7982802.	5.7114888	0.0014778	-0.001304	4.5323320	8.5748269
42.4542581 C							

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0.0002688	2142.	7969031.	5.6886472	0.0015288	-0.001360	4.6026176	8.7281991
43.9169804 C							
0.0002788	2218.	7955834.	5.6676272	0.0015799	-0.001417	4.6672453	8.8830491
45.3811803 C							
0.0002888	2294.	7943151.	5.6482406	0.0016309	-0.001473	4.7261982	9.0393850
46.8468662 C							
0.0002988	2369.	7930899.	5.6302502	0.0016820	-0.001530	4.7794369	9.1965731
48.3134043 C							
0.0003088	2445.	7919054.	5.6135702	0.0017332	-0.001586	4.8269651	9.3550601
49.7812413 C							
0.0003188	2521.	7907584.	5.5981007	0.0017844	-0.001642	4.8687732	9.5150617
51.2505929 C							
0.0003288	2595.	7894732.	5.5841970	0.0018358	-0.001698	4.9049434	9.6810191
52.0000000 CY							
0.0003388	2668.	7875159.	5.5732338	0.0018879	-0.001754	4.9356813	9.8677988
52.0000000 CY							
0.0003488	2736.	7845280.	5.5661978	0.0019412	-0.001808	4.9609185	10.0879381
52.0000000 CY							
0.0003588	2799.	7801166.	5.5617448	0.0019953	-0.001861	4.9801370	10.3308682
52.0000000 CY							
0.0003688	2854.	7740015.	5.5587103	0.0020498	-0.001914	4.9929907	10.5863875
52.0000000 CY							
0.0003788	2903.	7664190.	5.5560049	0.0021043	-0.001967	4.9993010	10.8437612
52.0000000 CY							
0.0003888	2946.	7576961.	5.5523222	0.0021585	-0.002021	4.9998060	11.0885480
52.0000000 CY							
0.0003988	2983.	7480186.	5.5471638	0.0022119	-0.002075	4.9999807	11.3141338
52.0000000 CY							
0.0004088	3016.	7378242.	5.5413646	0.0022650	-0.002129	4.9989686	11.5291317
52.0000000 CY							
0.0004188	3046.	7273608.	5.5353163	0.0023179	-0.002184	4.9983261	11.7377405
52.0000000 CY							
0.0004288	3073.	7167644.	5.5291088	0.0023706	-0.002238	4.9983853	11.9408629
52.0000000 CY							
0.0004388	3098.	7060989.	5.5230457	0.0024232	-0.002293	4.9982530	12.1422212
52.0000000 CY							
0.0004488	3121.	6954579.	5.5170838	0.0024758	-0.002348	4.9979050	12.3413803
52.0000000 CY							
0.0004588	3142.	6848710.	5.5110316	0.0025282	-0.002403	4.9999610	12.5358791
52.0000000 CY							
0.0004688	3161.	6744091.	5.5050351	0.0025805	-0.002459	4.9999427	12.7276260
52.0000000 CY							
0.0004788	3179.	6640738.	5.4993503	0.0026328	-0.002514	4.9996943	12.9202239
52.0000000 CY							
0.0004888	3196.	6539042.	5.4939388	0.0026852	-0.002569	4.9991205	13.1133965
52.0000000 CY							
0.0004988	3212.	6439470.	5.4886360	0.0027375	-0.002624	4.9980495	13.3050013
52.0000000 CY							
0.0005088	3226.	6341063.	5.4833977	0.0027897	-0.002679	4.9999907	13.4944854
52.0000000 CY							
0.0005188	3240.	6244863.	5.4784186	0.0028419	-0.002735	4.9995583	13.6848284
52.0000000 CY							
0.0005288	3252.	6150967.	5.4737009	0.0028942	-0.002790	4.9983002	13.8762911
52.0000000 CY							
0.0005388	3264.	6058505.	5.4690386	0.0029464	-0.002845	4.9999943	14.0658863
52.0000000 CY							
0.0005488	3275.	5968502.	5.4645113	0.0029987	-0.002900	4.9993186	14.2549225
52.0000000 CY							
0.0006088	3329.	5468954.	5.4414601	0.0033125	-0.003232	4.9999437	15.4066080
52.0000000 CY							
0.0006688	3368.	5035852.	5.4235177	0.0036270	-0.003562	4.9991445	16.5771532
52.0000000 CY							
0.0007288	3396.	4659409.	5.4096561	0.0039423	-0.003892	4.9999345	17.7715020
52.0000000 CY							

Summary of Results for Nominal Moment Capacity for Section 1

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Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	99.370	3284.292	0.00300000	-0.00311437
2	137.970	3275.448	0.00300000	-0.00290184

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	99.370000	3284.	64.590500	2135.	7927864.
2	0.65	137.970000	3275.	89.680500	2129.	7971317.
1	0.75	99.370000	3284.	74.527500	2463.	7882429.
2	0.75	137.970000	3275.	103.477500	2457.	7917296.
1	0.90	99.370000	3284.	89.433000	2956.	7517318.
2	0.90	137.970000	3275.	124.173000	2948.	7570820.

Pile Section No. 2:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	5.500000 ft
Shaft Diameter	=	9.560000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.655000 in
Number of Reinforcing Bars	=	1 bar
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	71.780366 sq. in.
Total Area of Reinforcing Steel	=	2.250000 sq. in.
Area Ratio of Steel Reinforcement	=	3.13 percent
Edge-to-Edge Bar Spacing	=	-1.69300 in
Maximum Concrete Aggregate Size	=	0.375000 in
Ratio of Bar Spacing to Aggregate Size	=	-4.51
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = $0.85 F_c A_c + F_y A_s$	=	430.504 kips
Tensile Load for Cracking of Concrete	=	-39.723 kips
Nominal Axial Tensile Capacity	=	-135.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar	Bar Diam.	Bar Area	X	Y
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Number	inches	sq. in.	inches	inches
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1	1.693000	2.250000	0.00000	0.00000

NOTE: The positions of the above rebars were computed by LPILE

Concrete Properties:

Compressive Strength of Concrete	=	5000. psi
Modulus of Elasticity of Concrete	=	4030509. psi
Modulus of Rupture of Concrete	=	-530.33009 psi
Compression Strain at Peak Stress	=	0.002109
Tensile Strain at Fracture of Concrete	=	-0.0001150
Maximum Coarse Aggregate Size	=	0.375000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
-----	-----
1	99.370
2	137.970

Definitions of Run Messages and Notes:

- C = concrete in section has cracked in tension.
- Y = stress in reinforcing steel has reached yield stress.
- T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
- Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 99.370 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
-----	-----	-----	-----	-----	-----	-----	-----	-----
0.00000125	2.1401984	1712159.	217.2303269	0.0002715	0.0002596	1.2044328	7.7307811	
0.00000250	4.2772424	1710897.	111.0075898	0.0002775	0.0002536	1.2288565	7.7604138	
0.00000375	6.4142583	1710469.	75.6010967	0.0002835	0.0002477	1.2532181	7.7901645	
0.00000500	8.5512322	1710246.	57.8986646	0.0002895	0.0002417	1.2775175	7.8200334	
0.00000625	10.6881500	1710104.	47.2778569	0.0002955	0.0002357	1.3017543	7.8500203	
0.00000750	12.8249977	1710000.	40.1978614	0.0003015	0.0002298	1.3259286	7.8801254	
0.00000875	14.9617610	1709916.	35.1411872	0.0003075	0.0002238	1.3500401	7.9103485	
0.00001000	17.0984261	1709843.	31.3490888	0.0003135	0.0002179	1.3740887	7.9406898	
0.00001125	19.2349787	1709776.	28.4000410	0.0003195	0.0002120	1.3980742	7.9711492	
0.00001250	21.3714049	1709712.	26.0411286	0.0003255	0.0002060	1.4219965	8.0017266	
0.00001375	23.5076906	1709650.	24.1114056	0.0003315	0.0002001	1.4458553	8.0324223	
0.00001500	25.6438216	1709588.	22.5035746	0.0003376	0.0001942	1.4696505	8.0632360	
0.00001625	27.7797840	1709525.	21.1433530	0.0003436	0.0001882	1.4933820	8.0941679	
0.00001750	29.9155636	1709461.	19.9776815	0.0003496	0.0001823	1.5170495	8.1252179	
0.00001875	32.0511464	1709394.	18.9676502	0.0003556	0.0001764	1.5406530	8.1563861	
0.00002000	34.1865183	1709326.	18.0840765	0.0003617	0.0001705	1.5641923	8.1876724	
0.00002125	36.3216652	1709255.	17.3046445	0.0003677	0.0001646	1.5876672	8.2190770	
0.00002250	38.4565731	1709181.	16.6119971	0.0003738	0.0001587	1.6110775	8.2505997	

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0.00002375	40.5912277	1709104.	15.9924316	0.0003798	0.0001528	1.6344231	8.2822406
0.00002500	42.7256151	1709025.	15.4349856	0.0003859	0.0001469	1.6577037	8.3139997
0.00002625	44.8597212	1708942.	14.9307851	0.0003919	0.0001410	1.6809194	8.3458770
0.00002750	46.9935319	1708856.	14.4725692	0.0003980	0.0001351	1.7040698	8.3778725
0.00002875	49.1270330	1708766.	14.0543401	0.0004041	0.0001292	1.7271549	8.4099864
0.00003000	51.2602106	1708674.	13.6710992	0.0004101	0.0001233	1.7501744	8.4422184
0.00003125	53.3930504	1708578.	13.3186482	0.0004162	0.0001175	1.7731282	8.4745688
0.00003250	55.5255383	1708478.	12.9934343	0.0004223	0.0001116	1.7960161	8.5070374
0.00003375	57.6576604	1708375.	12.6924311	0.0004284	0.0001057	1.8188381	8.5396243
0.00003500	59.7894024	1708269.	12.4130448	0.0004345	0.00009986	1.8415938	8.5723296
0.00003625	61.9207502	1708159.	12.1530391	0.0004405	0.00009400	1.8642831	8.6051532
0.00003750	64.0516898	1708045.	11.9104759	0.0004466	0.00008814	1.8869060	8.6380952
0.00003875	66.1822070	1707928.	11.6836673	0.0004527	0.00008229	1.9094621	8.6711555
0.00004000	68.3122876	1707807.	11.4711363	0.0004588	0.00007645	1.9319514	8.7043343
0.00004125	70.4419177	1707683.	11.2715850	0.0004650	0.00007060	1.9543737	8.7376314
0.00004250	72.5710829	1707555.	11.0838681	0.0004711	0.00006476	1.9767288	8.7710470
0.00004375	74.6997692	1707423.	10.9069712	0.0004772	0.00005893	1.9990166	8.8045811
0.00004500	76.8279625	1707288.	10.7399927	0.0004833	0.00005310	2.0212369	8.8382336
0.00004625	78.9556486	1707149.	10.5821285	0.0004894	0.00004727	2.0433895	8.8720047
0.00004750	81.0828133	1707007.	10.4326589	0.0004956	0.00004145	2.0654743	8.9058943
0.00004875	83.2094425	1706860.	10.2909383	0.0005017	0.00003563	2.0874910	8.9399024
0.00005125	87.4610377	1706557.	10.0824761	0.0005140	0.00002401	2.1313199	9.0082744
0.00005375	91.7103209	1706239.	9.7907333	0.0005263	0.00001240	2.1748749	9.0771210
0.00005625	95.9571787	1705905.	9.5744143	0.0005386	8.10807E-07	2.2181545	9.1464423
0.00005875	100.2014061	1705556.	9.3767833	0.0005509	-0.00001076	2.2611574	9.2162369
0.00006125	104.4421094	1705177.	9.1955439	0.0005632	-0.00002232	2.3038804	9.2864908
0.00006375	108.6778923	1704751.	9.0287547	0.0005756	-0.00003387	2.3463194	9.3571796
0.00006625	112.9073046	1704261.	8.8747660	0.0005880	-0.00004540	2.3884700	9.4282771
0.00006875	117.1289881	1703694.	8.7321686	0.0006003	-0.00005691	2.4303281	9.4997575
0.00007125	121.3416782	1703041.	8.5997512	0.0006127	-0.00006842	2.4718896	9.5715958
0.00007375	125.5442686	1702295.	8.4764681	0.0006251	-0.00007991	2.5131510	9.6437695
0.00007625	129.7357771	1701453.	8.3614114	0.0006376	-0.00009139	2.5541088	9.7162579
0.00007875	133.9153220	1700512.	8.2537893	0.0006500	-0.000103	2.5947600	9.7890417
0.00008125	133.9153220	1648189.	8.0981520	0.0006580	-0.000119	2.6205713	9.7330847 C
0.00008375	134.7779111	1609288.	7.9933035	0.0006694	-0.000131	2.6575365	9.7779133 C
0.00008625	137.5557409	1594849.	7.8935897	0.0006808	-0.000144	2.6939503	9.8203822 C
0.00008875	140.2336457	1580097.	7.7986005	0.0006921	-0.000156	2.7298256	9.8605527 C
0.00009125	142.8176102	1565124.	7.7079773	0.0007034	-0.000169	2.7651770	9.8985030 C
0.00009375	145.3138448	1550014.	7.6214059	0.0007145	-0.000182	2.8000205	9.9343287 C
0.00009625	147.7287232	1534844.	7.5386107	0.0007256	-0.000195	2.8343738	9.9681422 C
0.00009875	150.0687277	1519683.	7.4593503	0.0007366	-0.000207	2.8682557	10.0000728 C
0.0001013	152.3403996	1504597.	7.3834127	0.0007476	-0.000220	2.9016866	10.0302677 C
0.0001038	154.5502928	1489641.	7.3106126	0.0007585	-0.000233	2.9346881	10.0588913 C
0.0001063	156.6786685	1474623.	7.2404907	0.0007693	-0.000246	2.9671877	10.0852085 C
0.0001088	158.7510053	1459779.	7.1731125	0.0007801	-0.000260	2.9992731	10.1100142 C
0.0001113	160.7769550	1445186.	7.1083894	0.0007908	-0.000273	3.0309798	10.1336159 C
0.0001138	162.7394186	1430676.	7.0459467	0.0008015	-0.000286	3.0622438	10.1553563 C
0.0001163	164.6480081	1416327.	6.9857192	0.0008121	-0.000299	3.0930973	10.1755090 C
0.0001188	166.5254176	1402319.	6.9278110	0.0008227	-0.000313	3.1236285	10.1949157 C
0.0001213	168.3319516	1388305.	6.8716274	0.0008332	-0.000326	3.1536813	10.2119885 C
0.0001238	170.1120696	1374643.	6.8175358	0.0008437	-0.000339	3.1834288	10.2284248 C
0.0001263	171.8427123	1361130.	6.7651554	0.0008541	-0.000353	3.2127802	10.2432800 C
0.0001288	173.5367051	1347858.	6.7145101	0.0008645	-0.000366	3.2417845	10.2570215 C
0.0001313	175.1941607	1334813.	6.6655005	0.0008748	-0.000380	3.2704441	10.2696449 C
0.0001338	176.8130105	1321966.	6.6179960	0.0008852	-0.000393	3.2987469	10.2809980 C
0.0001363	178.3999878	1309358.	6.5719869	0.0008954	-0.000407	3.3267239	10.2913736 C
0.0001388	179.9544899	1296969.	6.5273718	0.0009057	-0.000421	3.3543692	10.3006870 C
0.0001413	181.4737243	1284770.	6.4840441	0.0009159	-0.000434	3.3816728	10.3088030 C
0.0001438	182.9743498	1272865.	6.4421121	0.0009261	-0.000448	3.4087054	10.3164562 C
0.0001463	184.4286160	1261050.	6.40011892	0.0009362	-0.000462	3.4353455	10.3223081 C
0.0001488	185.8793718	1249609.	6.3617004	0.0009463	-0.000476	3.4617838	10.3284136 C
0.0001588	191.3623348	1205432.	6.2135743	0.0009864	-0.000531	3.5642319	10.3408255 C
0.0001688	196.5149738	1164533.	6.0807671	0.0010261	-0.000587	3.6622242	10.3422907 C
0.0001788	201.3500623	1126434.	5.9606156	0.0010655	-0.000643	3.7558216	10.3323320 C
0.0001888	205.9176444	1090954.	5.8514475	0.0011045	-0.000700	3.8452733	10.3128058 C
0.0001988	210.2592451	1057908.	5.7519051	0.0011432	-0.000757	3.9307957	10.2854417 C
0.0002088	214.3999741	1027066.	5.6607625	0.0011817	-0.000814	4.0125280	10.2511939 C
0.0002188	218.3648523	998239.	5.5770517	0.0012200	-0.000871	4.0906123	10.2112285 C
0.0002288	222.1752140	971258.	5.4999638	0.0012581	-0.000929	4.1651724	10.1666455 C

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0.0002388	225.8281682	945877.	5.4285437	0.0012961	-0.000986	4.2361944	10.1165941 C
0.0002488	229.3676634	922081.	5.3625592	0.0013339	-0.001044	4.3039246	10.0643304 C
0.0002588	232.8108931	899752.	5.3015708	0.0013718	-0.001102	4.3684654	10.0112852 C
0.0002688	236.1233808	878599.	5.2445563	0.0014095	-0.001160	4.4296236	9.9538378 C
0.0002788	239.3585270	858685.	5.1916994	0.0014472	-0.001218	4.4876962	9.8969308 C
0.0002888	242.4944784	839808.	5.1422921	0.0014848	-0.001276	4.5425640	9.8382533 C
0.0002988	245.5531901	821935.	5.0962310	0.0015225	-0.001334	4.5943402	9.7799028 C
0.0003088	248.5222324	804930.	5.0530282	0.0015601	-0.001392	4.6429590	9.7204399 C
0.0003188	251.4315020	788805.	5.0127861	0.0015978	-0.001449	4.6885696	9.6632871 C
0.0003288	254.2422852	773361.	4.9747182	0.0016354	-0.001507	4.7309654	9.6035197 C
0.0003388	257.0018490	758677.	4.9392534	0.0016732	-0.001565	4.7703830	9.5472455 C
0.0003488	259.6845519	744615.	4.9058167	0.0017109	-0.001623	4.8066780	9.4909131 C
0.0003588	262.2933219	731131.	4.8742797	0.0017486	-0.001681	4.8398633	9.4349506 C
0.0003688	264.8497665	718237.	4.8447911	0.0017865	-0.001739	4.8700213	9.3826038 C
0.0003788	267.3380643	705843.	4.8169671	0.0018244	-0.001796	4.8970635	9.3314334 C
0.0003888	269.7500428	693891.	4.7905618	0.0018623	-0.001854	4.9209524	9.2801212 C
0.0003988	272.1084416	682404.	4.7658062	0.0019004	-0.001912	4.9417583	-9.560835 C
0.0004088	274.4124090	671345.	4.7425844	0.0019385	-0.001969	4.9594490	-10.075872 C
0.0004188	276.6454502	660646.	4.7205371	0.0019767	-0.002027	4.9739554	-10.590113 C
0.0004288	278.8094335	650284.	4.6996166	0.0020150	-0.002084	4.9852744	-11.103131 C
0.0004388	280.9715107	640268.	4.6799650	0.0020533	-0.002141	4.9934117	-11.612139 C
0.0004488	282.9687542	630571.	4.6615027	0.0020918	-0.002198	4.9983323	-12.117066 C
0.0004588	284.9622086	621171.	4.6441574	0.0021305	-0.002255	4.9999999	-12.617841 C
0.0004688	286.8785978	612008.	4.6276835	0.0021692	-0.002312	4.9999464	-13.116833 C
0.0004788	288.7177477	603066.	4.6120731	0.0022080	-0.002369	4.9997366	-13.613389 C
0.0004888	290.4892932	594351.	4.5974423	0.0022470	-0.002425	4.9992718	-14.105115 C
0.0004988	292.1944156	585853.	4.5837308	0.0022861	-0.002482	4.9984324	-14.592030 C
0.0005088	293.8337464	577560.	4.5708849	0.0023254	-0.002538	4.9999938	-15.074128 C
0.0005188	295.4030205	569452.	4.5588738	0.0023649	-0.002594	4.9996843	-15.551117 C
0.0005288	296.9105458	561533.	4.5476231	0.0024046	-0.002650	4.9987813	-16.023414 C
0.0005388	298.3553571	553792.	4.5369805	0.0024443	-0.002706	4.9997321	-16.492736 C
0.0005488	299.7257435	546197.	4.5268926	0.0024841	-0.002762	4.9996261	-16.959401 C
0.0006088	306.8173721	504012.	4.4787009	0.0027264	-0.003093	4.9971480	-19.664503 C
0.0006688	312.1869201	466822.	4.4471168	0.0029740	-0.003419	4.9991105	-22.215213 C
0.0007288	316.1271058	433794.	4.4268313	0.0032261	-0.003741	4.9988204	-24.637062 C
0.0007888	318.9178594	404333.	4.4152236	0.0034825	-0.004058	4.9994856	-26.931011 C
0.0008488	320.7410567	377898.	4.4100665	0.0037430	-0.004371	4.9990381	-29.106583 C
0.0009088	320.7410567	352948.	4.4367762	0.0040319	-0.004656	4.9988692	-30.460290 C

Axial Thrust Force = 137.970 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	2.0126045	1610084.	306.8215436	0.0003835	0.0003716	1.6530016	10.9784627	
0.00000250	4.0207065	1608283.	155.8033244	0.0003895	0.0003656	1.6759355	11.0081045	
0.00000375	6.0287790	1607674.	105.4650606	0.0003955	0.0003596	1.6988072	11.0378706	
0.00000500	8.0368073	1607361.	80.2967855	0.0004015	0.0003537	1.7216163	11.0677609	
0.00000625	10.0447766	1607164.	65.1965060	0.0004075	0.0003477	1.7443627	11.0977753	
0.00000750	12.0526721	1607023.	55.1302243	0.0004135	0.0003418	1.7670463	11.1279141	
0.00000875	14.0604789	1606912.	47.9405128	0.0004195	0.0003358	1.7896669	11.1581772	
0.00001000	16.0681822	1606818.	42.5486576	0.0004255	0.0003299	1.8122243	11.1885646	
0.00001125	18.0757673	1606735.	38.3553734	0.0004315	0.0003239	1.8347183	11.2190762	
0.00001250	20.0832194	1606658.	35.0010889	0.0004375	0.0003180	1.8571488	11.2497121	
0.00001375	22.0905236	1606584.	32.2569860	0.0004435	0.0003121	1.8795156	11.2804723	
0.00001500	24.0976651	1606511.	29.9705193	0.0004496	0.0003062	1.9018185	11.3113568	
0.00001625	26.1046292	1606439.	28.0360804	0.0004556	0.0003002	1.9240574	11.3423656	
0.00001750	28.1114010	1606366.	26.3782349	0.0004616	0.0002943	1.9462320	11.3734987	
0.00001875	30.1179657	1606292.	24.9416641	0.0004677	0.0002884	1.9683423	11.4047561	
0.00002000	32.1243084	1606215.	23.6848791	0.0004737	0.0002825	1.9903880	11.4361378	
0.00002125	34.1304145	1606137.	22.5761528	0.0004797	0.0002766	2.0123689	11.4676439	
0.00002250	36.1362690	1606056.	21.5908090	0.0004858	0.0002707	2.0342850	11.4992743	
0.00002375	38.1418572	1605973.	20.7093661	0.0004918	0.0002648	2.0561360	11.5310291	
0.00002500	40.1471641	1605887.	19.9162390	0.0004979	0.0002589	2.0779217	11.5629084	
0.00002625	42.1521750	1605797.	19.1988113	0.0005040	0.0002530	2.0996420	11.5949119	
0.00002750	44.1568751	1605705.	18.5467603	0.0005100	0.0002471	2.1212967	11.6270399	
0.00002875	46.1612495	1605609.	17.9515586	0.0005161	0.0002413	2.1428857	11.6592923	

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0.00003000	48.1652834	1605509.	17.4061001	0.0005222	0.0002354	2.1644087	11.6916692
0.00003125	50.1689620	1605407.	16.9044156	0.0005283	0.0002295	2.1858656	11.7241705
0.00003250	52.1722703	1605301.	16.4414543	0.0005343	0.0002236	2.2072563	11.7567963
0.00003375	54.1751936	1605191.	16.0129137	0.0005404	0.0002178	2.2285805	11.7895466
0.00003500	56.1777171	1605078.	15.6151057	0.0005465	0.0002119	2.2498380	11.8224214
0.00003625	58.1798257	1604961.	15.2448513	0.0005526	0.0002061	2.2710288	11.8554207
0.00003750	60.1815048	1604840.	14.8993950	0.0005587	0.0002002	2.2921526	11.8885446
0.00003875	62.1827394	1604716.	14.5763371	0.0005648	0.0001944	2.3132092	11.9217931
0.00004000	64.1835147	1604588.	14.2735777	0.0005709	0.0001885	2.3341986	11.9551662
0.00004125	66.1838157	1604456.	13.9892715	0.0005771	0.0001827	2.3551204	11.9886639
0.00004250	68.1836277	1604321.	13.7217904	0.0005832	0.0001769	2.3759746	12.0222863
0.00004375	70.1829357	1604181.	13.4696922	0.0005893	0.0001710	2.3967610	12.0560334
0.00004500	72.1817248	1604038.	13.2316950	0.0005954	0.0001652	2.4174793	12.0899051
0.00004625	74.1799802	1603891.	13.0066555	0.0006016	0.0001594	2.4381295	12.1239016
0.00004750	76.1776869	1603741.	12.7935508	0.0006077	0.0001536	2.4587114	12.1580228
0.00004875	78.1748301	1603586.	12.5914627	0.0006138	0.0001478	2.4792247	12.1922688
0.00005125	82.1673662	1603266.	12.2171125	0.0006261	0.0001362	2.5200450	12.2611354
0.00005375	86.1574692	1602930.	11.8779060	0.0006384	0.0001246	2.5605892	12.3305014
0.00005625	90.1450195	1602578.	11.5691575	0.0006508	0.0001130	2.6008559	12.4003671
0.00005875	94.1298977	1602211.	11.2869790	0.0006631	0.0001015	2.6408436	12.4707329
0.00006125	98.1119841	1601828.	11.0281171	0.0006755	0.0000892	2.6805509	12.5415989
0.00006375	102.0911589	1601430.	10.7898289	0.0006879	0.00007840	2.7199765	12.6129656
0.00006625	106.0673023	1601016.	10.5697854	0.0007002	0.00006690	2.7591190	12.6848331
0.00006875	110.0402942	1600586.	10.3659964	0.0007127	0.00005541	2.7979770	12.7572018
0.00007125	114.0100146	1600141.	10.1767511	0.0007251	0.00004394	2.8365491	12.8300720
0.00007375	117.9763432	1599679.	10.0005707	0.0007375	0.00003249	2.8748338	12.9034441
0.00007625	121.9391596	1599202.	9.8361702	0.0007500	0.00002106	2.9128298	12.9773183
0.00007875	125.8983431	1598709.	9.6824279	0.0007625	0.00000964	2.9505357	13.0516952
0.00008125	129.8537733	1598200.	9.5383601	0.0007750	-0.00000176	2.9879500	13.1265750
0.00008375	133.8052237	1597674.	9.4030998	0.0007875	-0.00001314	3.0250712	13.2019560
0.00008625	137.7520157	1597125.	9.2758768	0.0008000	-0.00002451	3.0618968	13.2778279
0.00008875	141.6932305	1596543.	9.1560059	0.0008126	-0.00003585	3.0984236	13.3541748
0.00009125	145.6278930	1595922.	9.0428762	0.0008252	-0.00004719	3.1346487	13.4309792
0.00009375	149.5550311	1595254.	8.9359418	0.0008377	-0.00005851	3.1705689	13.5082232
0.00009625	153.4737093	1594532.	8.8347134	0.0008503	-0.00006981	3.2061811	13.5858888
0.00009875	157.3830548	1593752.	8.7387518	0.0008630	-0.00008110	3.2414825	13.6639590
0.0001013	161.2822559	1592911.	8.6476612	0.0008756	-0.00009237	3.2764704	13.7424173
0.0001038	165.1705623	1592005.	8.5610845	0.0008882	-0.000104	3.3111422	13.8212485
0.0001063	165.1705623	1554546.	8.4494053	0.0008977	-0.000118	3.3369950	13.8101792 C
0.0001088	167.8633578	1543571.	8.3651862	0.0009097	-0.000130	3.3692297	13.8695185 C
0.0001113	170.7519580	1534849.	8.2841367	0.0009216	-0.000142	3.4009654	13.9268720 C
0.0001138	173.5606798	1525808.	8.2061655	0.0009335	-0.000154	3.4322430	13.9826280 C
0.0001163	176.2951778	1516518.	8.1311048	0.0009452	-0.000166	3.4630762	14.0368902 C
0.0001188	178.9613751	1507043.	8.0588067	0.0009570	-0.000178	3.4934802	14.0897822 C
0.0001213	181.5569624	1497377.	7.9890703	0.0009687	-0.000190	3.5234494	14.1411985 C
0.0001238	184.0673312	1487413.	7.9216022	0.0009803	-0.000203	3.5529441	14.1906435 C
0.0001263	186.5232739	1477412.	7.8565036	0.0009919	-0.000215	3.5820448	14.2389811 C
0.0001288	188.9281426	1467403.	7.7936602	0.0010034	-0.000227	3.6107620	14.2862994 C
0.0001313	191.2457420	1457110.	7.7326302	0.0010149	-0.000240	3.6389970	14.3314077 C
0.0001338	193.5237407	1446906.	7.6736888	0.0010264	-0.000252	3.6668789	14.3757681 C
0.0001363	195.7447243	1436659.	7.6165753	0.0010378	-0.000265	3.6943616	14.4188042 C
0.0001388	197.9031577	1426329.	7.5611289	0.0010491	-0.000277	3.7214278	14.4602643 C
0.0001413	200.0327039	1416161.	7.5075366	0.0010604	-0.000290	3.7481745	14.5012849 C
0.0001438	202.0823117	1405790.	7.4552662	0.0010717	-0.000303	3.7744554	14.5400427 C
0.0001463	204.1160879	1395666.	7.4047748	0.0010829	-0.000315	3.8004546	14.5787663 C
0.0001488	206.0742470	1385373.	7.3554683	0.0010941	-0.000328	3.8260000	14.6152784 C
0.0001588	213.5496552	1345195.	7.1719774	0.0011386	-0.000379	3.9248059	14.7530693 C
0.0001688	220.4361198	1306288.	7.0071783	0.0011825	-0.000431	4.0181866	14.8759154 C
0.0001788	226.7985335	1268803.	6.8581422	0.0012259	-0.000483	4.1063671	14.9848851 C
0.0001888	232.7172259	1232939.	6.7227483	0.0012689	-0.000536	4.1896247	15.0820857 C
0.0001988	238.2299146	1198641.	6.5990342	0.0013116	-0.000588	4.2681110	15.1680814 C
0.0002088	243.4058520	1166016.	6.4857166	0.0013539	-0.000642	4.3420777	15.2452582 C
0.0002188	248.2735064	1134965.	6.3814695	0.0013959	-0.000695	4.4116462	15.3142538 C
0.0002288	252.8606749	1105402.	6.2852143	0.0014377	-0.000749	4.4769344	15.3758010 C
0.0002388	257.1943918	1077254.	6.1960699	0.0014793	-0.000803	4.5380564	15.4307535 C
0.0002488	261.3007194	1050455.	6.1133136	0.0015207	-0.000857	4.5951205	15.4800852 C
0.0002588	265.2045890	1024945.	6.0363523	0.0015619	-0.000912	4.6482281	15.5249015 C
0.0002688	268.9296332	1000668.	5.9646991	0.0016030	-0.000966	4.6974722	15.5664505 C
0.0002788	272.4592739	977432.	5.8975719	0.0016439	-0.001021	4.7428205	15.6030280 C

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0.0002888	275.8221875	955228.	5.8346943	0.0016848	-0.001076	4.7843749	15.6362567	C
0.0002988	279.0601468	934093.	5.7760124	0.0017256	-0.001130	4.8222663	15.6693664	C
0.0003088	282.1214126	913754.	5.7205887	0.0017662	-0.001185	4.8563646	15.6976143	C
0.0003188	285.0703069	894338.	5.6686920	0.0018069	-0.001240	4.8868459	15.7263189	C
0.0003288	287.8800809	875681.	5.6197332	0.0018475	-0.001295	4.9136512	15.7529325	C
0.0003388	290.5800017	857801.	5.5737081	0.0018881	-0.001350	4.9368464	15.7799701	C
0.0003488	293.1537907	840584.	5.5301971	0.0019287	-0.001405	4.9564016	15.8057401	C
0.0003588	295.6417683	824089.	5.4893876	0.0019693	-0.001460	4.9723789	15.8343796	C
0.0003688	297.9941246	808120.	5.4505335	0.0020099	-0.001515	4.9847007	15.8602605	C
0.0003788	300.2751074	792806.	5.4141565	0.0020506	-0.001570	4.9934367	15.8908128	C
0.0003888	302.4414967	777985.	5.3795946	0.0020913	-0.001625	4.9985284	15.9207301	C
0.0003988	304.5103110	763662.	5.3469144	0.0021321	-0.001680	4.9986994	15.9523608	C
0.0004088	306.4966671	749839.	5.3162766	0.0021730	-0.001735	4.9987325	15.9892468	C
0.0004188	308.3616057	736386.	5.2871367	0.0022140	-0.001789	4.9986196	16.0265448	C
0.0004288	310.1217099	723316.	5.2595753	0.0022550	-0.001844	4.9988167	16.0665818	C
0.0004388	311.7966670	710648.	5.2337087	0.0022963	-0.001898	4.9999979	16.1121959	C
0.0004488	313.3849684	698351.	5.2094102	0.0023377	-0.001952	4.9999426	16.1632109	C
0.0004588	314.8526867	686327.	5.1860585	0.0023791	-0.002007	4.9997512	16.2127297	C
0.0004688	316.2443977	674655.	5.1640981	0.0024207	-0.002061	4.9993341	16.2676159	C
0.0004788	317.5635589	663318.	5.1434317	0.0024624	-0.002114	4.9985809	16.3277306	C
0.0004888	318.8125825	652302.	5.1239735	0.0025043	-0.002168	4.9999966	16.3929838	C
0.0004988	319.9720168	641548.	5.1054520	0.0025463	-0.002222	4.9997287	16.4604993	C
0.0005088	321.0541372	631065.	5.0877673	0.0025884	-0.002275	4.9989059	16.5296189	C
0.0005188	322.0785620	620874.	5.0710729	0.0026306	-0.002329	4.9995641	16.6033787	C
0.0005288	323.0349609	610941.	5.0553579	0.0026730	-0.002382	4.9996673	16.6824734	C
0.0005388	323.9382386	601277.	5.0405112	0.0027156	-0.002435	4.9984488	16.7660200	C
0.0005488	324.7882025	591869.	5.0264875	0.0027583	-0.002488	4.9999542	16.8540537	C
0.0006088	328.7406128	540026.	4.9555569	0.0030167	-0.002803	4.9974567	17.4446756	C
0.0006688	331.1773634	495218.	4.9040549	0.0032796	-0.003114	4.9998360	18.1652525	C
0.0007288	332.4179940	456148.	4.8663268	0.0035463	-0.003421	4.9959125	18.9976960	C
0.0007888	332.7208043	421833.	4.8393037	0.0038170	-0.003723	4.9954067	19.9437102	C

Summary of Results for Nominal Moment Capacity for Section 2

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	99.370	312.593	0.00300000	-0.00345240
2	137.970	328.485	0.00300000	-0.00278259

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (ϕ -factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in ²
1	0.65	99.370000	312.593230	64.590500	203.185599	1112176.
2	0.65	137.970000	328.485257	89.680500	213.515417	1345379.
1	0.75	99.370000	312.593230	74.527500	234.444922	889317.
2	0.75	137.970000	328.485257	103.477500	246.363943	1147146.

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1	0.90	99.370000	312.593230	89.433000	281.333907	638299.
2	0.90	137.970000	328.485257	124.173000	295.636732	824122.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	81556.
2	13.0000	13.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 20290.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 137970.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5973	-1310512.	20290.	0.00	0.00	8.17E+09	0.00	0.00	0.00
0.1950	0.5969	-1262973.	20284.	-3.69E-04	0.00	8.17E+09	-4.845	18.9941	0.00
0.3900	0.5956	-1215343.	20267.	-7.23E-04	0.00	8.20E+09	-10.372	40.7502	0.00
0.5850	0.5935	-1167659.	20235.	-0.00106	0.00	8.22E+09	-16.316	64.3287	0.00
0.7800	0.5906	-1119956.	20190.	-0.00139	0.00	8.24E+09	-22.429	88.8606	0.00
0.9750	0.5870	-1072274.	20130.	-0.00170	0.00	8.27E+09	-28.535	113.7484	0.00
1.1700	0.5827	-1024650.	20057.	-0.00199	0.00	8.29E+09	-34.473	138.4387	0.00
1.3650	0.5777	-977121.	19969.	-0.00228	0.00	8.31E+09	-40.043	162.1996	0.00
1.5600	0.5720	-929723.	19869.	-0.00254	0.00	8.34E+09	-45.745	187.1245	0.00
1.7550	0.5658	-882491.	19756.	-0.00280	0.00	8.37E+09	-50.906	210.5400	0.00
1.9500	0.5589	-835458.	19631.	-0.00304	0.00	8.40E+09	-55.773	233.4896	0.00
2.1450	0.5516	-788656.	19496.	-0.00326	0.00	8.44E+09	-59.998	254.5416	0.00
2.3400	0.5437	-742111.	19350.	-0.00348	0.00	8.47E+09	-64.308	276.7859	0.00
2.5350	0.5353	-695852.	19194.	-0.00367	0.00	8.51E+09	-68.891	301.1475	0.00
2.7300	0.5265	-649909.	19028.	-0.00386	0.00	8.56E+09	-73.444	326.4288	0.00
2.9250	0.5172	-604311.	18849.	-0.00403	0.00	8.60E+09	-79.814	361.0754	0.00
3.1200	0.5076	-559096.	18655.	-0.00419	0.00	8.65E+09	-86.062	396.7186	0.00
3.3150	0.4977	-514304.	18446.	-0.00433	0.00	8.71E+09	-92.136	433.2321	0.00
3.5100	0.4874	-469972.	18224.	-0.00446	0.00	8.76E+09	-97.986	470.4743	0.00
3.7050	0.4768	-426136.	17985.	-0.00458	0.00	8.94E+09	-105.802	519.2903	0.00
3.9000	0.4659	-382843.	17727.	-0.00469	0.00	8.94E+09	-115.192	578.5481	0.00
4.0950	0.4548	-340148.	17446.	-0.00478	0.00	8.94E+09	-124.920	642.6991	0.00
4.2900	0.4435	-298109.	17142.	-0.00487	0.00	8.94E+09	-134.979	712.1365	0.00
4.4850	0.4320	-256784.	16814.	-0.00494	0.00	8.94E+09	-145.384	787.4105	0.00

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4.6800	0.4204	-216233.	16460.	-0.00500	0.00	8.94E+09	-156.864	873.0985	0.00
4.8750	0.4086	-176522.	16079.	-0.00505	0.00	8.94E+09	-168.773	966.4387	0.00
5.0700	0.3968	-137721.	15672.	-0.00509	0.00	8.94E+09	-178.890	1055.	0.00
5.2650	0.3848	-99888.	15244.	-0.00512	0.00	8.94E+09	-187.032	1137.	0.00
5.4600	0.3728	-63070.	14797.	-0.00515	0.00	8.94E+09	-194.965	1224.	0.00
5.6550	0.3607	-27315.	14332.	-0.00516	0.00	8.94E+09	-202.664	1315.	0.00
5.8500	0.3486	7333.	13849.	-0.00516	0.00	8.94E+09	-210.107	1410.	0.00
6.0450	0.3366	40830.	13349.	-0.00515	0.00	8.94E+09	-217.272	1511.	0.00
6.2400	0.3245	73134.	12832.	-0.00514	0.00	8.94E+09	-224.140	1616.	0.00
6.4350	0.3125	104204.	12300.	-0.00512	0.00	8.94E+09	-230.694	1727.	0.00
6.6300	0.3006	134002.	11753.	-0.00508	0.00	8.94E+09	-236.918	1844.	0.00
6.8250	0.2887	162492.	11192.	-0.00505	0.00	8.94E+09	-242.800	1968.	0.00
7.0200	0.2770	189638.	10617.	-0.00500	0.00	8.94E+09	-248.330	2098.	0.00
7.2150	0.2653	215409.	10030.	-0.00495	0.00	8.94E+09	-253.498	2236.	0.00
7.4100	0.2538	239774.	9431.	-0.00489	0.00	8.94E+09	-258.298	2381.	0.00
7.6050	0.2425	262703.	8822.	-0.00482	0.00	8.94E+09	-262.726	2536.	0.00
7.8000	0.2313	284172.	8202.	-0.00475	0.00	8.94E+09	-266.780	2699.	0.00
7.9950	0.2202	304157.	7574.	-0.00467	0.00	8.94E+09	-270.459	2874.	0.00
8.1900	0.2094	322634.	6937.	-0.00459	0.00	8.94E+09	-273.765	3059.	0.00
8.3850	0.1987	339586.	6293.	-0.00450	0.00	8.94E+09	-276.702	3258.	0.00
8.5800	0.1883	354993.	5652.	-0.00441	0.00	8.94E+09	-271.443	3373.	0.00
8.7750	0.1781	368884.	5027.	-0.00432	0.00	8.94E+09	-262.549	3450.	0.00
8.9700	0.1681	381307.	4423.	-0.00422	0.00	8.94E+09	-253.326	3526.	0.00
9.1650	0.1583	392310.	3842.	-0.00412	0.00	8.94E+09	-243.809	3603.	0.00
9.3600	0.1488	401945.	3282.	-0.00401	0.00	8.94E+09	-234.030	3680.	0.00
9.5550	0.1396	410264.	2747.	-0.00391	0.00	8.94E+09	-224.023	3756.	0.00
9.7500	0.1305	417322.	2234.	-0.00380	0.00	8.94E+09	-213.820	3833.	0.00
9.9450	0.1218	423174.	1746.	-0.00369	0.00	8.94E+09	-203.453	3910.	0.00
10.1400	0.1133	427876.	1282.	-0.00358	0.00	8.94E+09	-192.954	3986.	0.00
10.3350	0.1050	431486.	843.1628	-0.00347	0.00	8.94E+09	-182.353	4063.	0.00
10.5300	0.09705	434060.	428.9451	-0.00335	0.00	8.94E+09	-171.679	4140.	0.00
10.7250	0.08933	435658.	39.7540	-0.00324	0.00	8.93E+09	-160.963	4216.	0.00
10.9200	0.08189	436338.	-324.342	-0.00312	0.00	8.93E+09	-150.230	4293.	0.00
11.1150	0.07471	436158.	-663.338	-0.00301	0.00	8.93E+09	-139.510	4370.	0.00
11.3100	0.06780	435177.	-977.292	-0.00290	0.00	8.93E+09	-128.827	4446.	0.00
11.5050	0.06116	433454.	-1266.	-0.00278	0.00	8.94E+09	-118.208	4523.	0.00
11.7000	0.05478	431047.	-1531.	-0.00267	0.00	8.94E+09	-107.675	4600.	0.00
11.8950	0.04867	428014.	-1770.	-0.00256	0.00	8.94E+09	-97.252	4676.	0.00
12.0900	0.04281	424413.	-1986.	-0.00245	0.00	8.94E+09	-86.961	4753.	0.00
12.2850	0.03722	420299.	-2178.	-0.00233	0.00	8.94E+09	-76.824	4829.	0.00
12.4800	0.03189	415729.	-2346.	-0.00222	0.00	8.94E+09	-66.860	4906.	0.00
12.6750	0.02681	410758.	-2491.	-0.00212	0.00	8.94E+09	-57.089	4983.	0.00
12.8700	0.02198	405440.	-2613.	-0.00201	0.00	8.94E+09	-47.530	5059.	0.00
13.0650	0.01740	399827.	-5222.	-0.00190	0.00	8.94E+09	-2182.	293367.	0.00
13.2600	0.01307	382233.	-9775.	-0.00180	0.00	8.94E+09	-1710.	306137.	0.00
13.4550	0.00897	355244.	-13207.	-0.00171	0.00	8.94E+09	-1223.	319157.	0.00
13.6500	0.00509	321525.	-15484.	-0.00162	0.00	8.94E+09	-722.785	332422.	0.00
13.8450	0.00140	283822.	-16572.	-0.00154	0.00	8.94E+09	-207.371	345943.	0.00
14.0400	-0.00211	244960.	-16587.	-0.00125	0.00	1.16E+09	194.5141	215857.	0.00
14.2350	-0.00446	207003.	-15887.	-8.30E-04	0.00	1.38E+09	404.2391	212071.	0.00
14.4300	-0.00599	171145.	-14786.	-5.23E-04	0.00	1.53E+09	536.8882	209710.	0.00
14.6250	-0.00691	138144.	-13438.	-2.92E-04	0.00	1.60E+09	615.2421	208347.	0.00
14.8200	-0.00736	108445.	-11954.	-1.11E-04	0.00	1.60E+09	652.9521	207722.	0.00
15.0150	-0.00743	82271.	-10418.	2.81E-05	0.00	1.60E+09	659.3787	207659.	0.00
15.2100	-0.00722	59669.	-8896.	1.32E-04	0.00	1.60E+09	642.1679	208015.	0.00
15.4050	-0.00681	40554.	-7433.	2.05E-04	0.00	1.61E+09	607.6455	208674.	0.00
15.6000	-0.00627	24748.	-6066.	2.52E-04	0.00	1.61E+09	561.0731	209538.	0.00
15.7950	-0.00563	12003.	-4817.	2.79E-04	0.00	1.61E+09	506.8166	210529.	0.00
15.9900	-0.00496	2026.	-3699.	2.89E-04	0.00	1.61E+09	448.4607	211583.	0.00
16.1850	-0.00428	-5495.	-2719.	2.87E-04	0.00	1.61E+09	388.8940	212649.	0.00
16.3800	-0.00362	-10885.	-1878.	2.75E-04	0.00	1.61E+09	330.3748	213688.	0.00
16.5750	-0.00299	-14460.	-1170.	2.56E-04	0.00	1.61E+09	274.5997	214671.	0.00
16.7700	-0.00242	-16525.	-587.901	2.34E-04	0.00	1.61E+09	222.7628	215579.	0.00
16.9650	-0.00190	-17362.	-121.795	2.09E-04	0.00	1.61E+09	175.6185	216399.	0.00
17.1600	-0.00144	-17230.	239.9276	1.84E-04	0.00	1.61E+09	133.5458	217126.	0.00
17.3550	-0.00104	-16358.	509.2128	1.59E-04	0.00	1.61E+09	96.6125	217761.	0.00
17.5500	-6.93E-04	-14950.	697.8761	1.37E-04	0.00	1.61E+09	64.6382	218307.	0.00
17.7450	-3.98E-04	-13180.	817.0893	1.16E-04	0.00	1.61E+09	37.2534	218771.	0.00
17.9400	-1.49E-04	-11201.	877.0031	9.85E-05	0.00	1.61E+09	13.9549	219164.	0.00

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18.1350	6.23E-05	-9139.	886.4978	8.36E-05	0.00	1.61E+09	-5.840	219300.	0.00
18.3300	2.42E-04	-7106.	853.1109	7.18E-05	0.00	1.61E+09	-22.696	219020.	0.00
18.5250	3.98E-04	-5193.	782.9701	6.29E-05	0.00	1.61E+09	-37.253	218781.	0.00
18.7200	5.37E-04	-3482.	680.7271	5.66E-05	0.00	1.61E+09	-50.134	218570.	0.00
18.9150	6.63E-04	-2044.	549.6605	5.25E-05	0.00	1.61E+09	-61.889	218380.	0.00
19.1100	7.83E-04	-943.744	391.8647	5.04E-05	0.00	1.61E+09	-72.979	218202.	0.00
19.3050	8.99E-04	-242.625	208.4856	4.95E-05	0.00	1.61E+09	-83.755	218030.	0.00
19.5000	0.00101	0.00	0.00	4.93E-05	0.00	1.61E+09	-94.438	108931.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.59733767 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -1310512. inch-lbs
 Maximum shear force = 20290. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 12
 Number of zero deflection points = 2

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 2, Shear and Slope

Shear = 20290. lbs
 Slope = 0.00000
 Axial Load = 137970. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
19.50000	0.59733767	-1310512.	20290.
18.52500	0.59969201	-1310674.	20290.
17.55000	0.60194412	-1311844.	20290.
16.57500	0.59713681	-1309885.	20290.
15.60000	0.60756717	-1314403.	20290.
14.62500	0.65856732	-1345465.	20290.
13.65000	0.74491162	-1409572.	20290.
12.67500	0.89528647	-1655787.	20290.
11.70000	0.91187007	-1715043.	20290.
10.72500	0.90280218	-1733111.	20290.
9.75000	0.90068837	-1707388.	20290.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 10600.0 lbs
 Rotation of pile head = 0.000E+00 radians
 Axial load at pile head = 99370.0 lbs

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(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2626	-635773.	10600.	0.00	0.00	8.41E+09	0.00	0.00	0.00
0.1950	0.2624	-610949.	10595.	-1.73E-04	0.00	8.41E+09	-4.080	36.3889	0.00
0.3900	0.2618	-586107.	10580.	-3.39E-04	0.00	8.46E+09	-8.674	77.5349	0.00
0.5850	0.2608	-561275.	10554.	-4.98E-04	0.00	8.48E+09	-13.576	121.8092	0.00
0.7800	0.2594	-536481.	10517.	-6.49E-04	0.00	8.51E+09	-18.576	167.5384	0.00
0.9750	0.2578	-511755.	10467.	-7.93E-04	0.00	8.54E+09	-23.509	213.4187	0.00
1.1700	0.2557	-487125.	10407.	-9.30E-04	0.00	8.57E+09	-28.238	258.3781	0.00
1.3650	0.2534	-462619.	10336.	-0.00106	0.00	8.60E+09	-32.577	300.8247	0.00
1.5600	0.2508	-438261.	10254.	-0.00118	0.00	8.64E+09	-36.915	344.4534	0.00
1.7550	0.2479	-414078.	10164.	-0.00130	0.00	8.67E+09	-40.694	384.1608	0.00
1.9500	0.2447	-390093.	10064.	-0.00140	0.00	8.71E+09	-44.184	422.5010	0.00
2.1450	0.2413	-366324.	9958.	-0.00151	0.00	8.97E+09	-47.066	456.4162	0.00
2.3400	0.2377	-342791.	9844.	-0.00160	0.00	8.97E+09	-49.738	489.7048	0.00
2.5350	0.2338	-319510.	9725.	-0.00168	0.00	8.97E+09	-52.268	523.0732	0.00
2.7300	0.2298	-296496.	9600.	-0.00176	0.00	8.98E+09	-54.488	554.8674	0.00
2.9250	0.2256	-273761.	9469.	-0.00184	0.00	8.98E+09	-57.719	598.7688	0.00
3.1200	0.2212	-251327.	9330.	-0.00191	0.00	8.98E+09	-60.474	639.7863	0.00
3.3150	0.2166	-229208.	9186.	-0.00197	0.00	8.98E+09	-62.675	676.9645	0.00
3.5100	0.2120	-207419.	9038.	-0.00203	0.00	8.98E+09	-64.245	709.2339	0.00
3.7050	0.2072	-185968.	8884.	-0.00208	0.00	8.98E+09	-67.487	762.3034	0.00
3.9000	0.2022	-164876.	8721.	-0.00212	0.00	8.98E+09	-71.969	832.7036	0.00
4.0950	0.1972	-144169.	8547.	-0.00216	0.00	8.98E+09	-76.359	905.9783	0.00
4.2900	0.1921	-123870.	8363.	-0.00220	0.00	8.98E+09	-80.628	982.0630	0.00
4.4850	0.1869	-104005.	8170.	-0.00223	0.00	8.98E+09	-84.781	1061.	0.00
4.6800	0.1817	-84599.	7965.	-0.00225	0.00	8.98E+09	-89.888	1158.	0.00
4.8750	0.1764	-65679.	7749.	-0.00227	0.00	8.98E+09	-94.986	1260.	0.00
5.0700	0.1711	-47276.	7521.	-0.00229	0.00	8.98E+09	-100.044	1369.	0.00
5.2650	0.1657	-29417.	7281.	-0.00230	0.00	8.98E+09	-105.042	1484.	0.00
5.4600	0.1603	-12132.	7029.	-0.00230	0.00	8.98E+09	-109.962	1605.	0.00
5.6550	0.1549	4552.	6767.	-0.00230	0.00	8.98E+09	-114.786	1734.	0.00
5.8500	0.1495	20607.	6492.	-0.00230	0.00	8.98E+09	-119.497	1870.	0.00
6.0450	0.1441	36006.	6207.	-0.00229	0.00	8.98E+09	-124.078	2014.	0.00
6.2400	0.1388	50724.	5912.	-0.00228	0.00	8.98E+09	-128.512	2167.	0.00
6.4350	0.1335	64735.	5606.	-0.00227	0.00	8.98E+09	-132.783	2328.	0.00
6.6300	0.1282	78015.	5291.	-0.00225	0.00	8.98E+09	-136.875	2499.	0.00
6.8250	0.1229	90541.	4966.	-0.00223	0.00	8.98E+09	-140.771	2679.	0.00
7.0200	0.1178	102290.	4639.	-0.00220	0.00	8.98E+09	-138.881	2760.	0.00
7.2150	0.1126	113273.	4316.	-0.00217	0.00	8.98E+09	-136.534	2836.	0.00
7.4100	0.1076	123502.	4000.	-0.00214	0.00	8.98E+09	-133.937	2913.	0.00
7.6050	0.1026	132989.	3690.	-0.00211	0.00	8.98E+09	-131.106	2990.	0.00
7.8000	0.09772	141751.	3387.	-0.00207	0.00	8.98E+09	-128.055	3066.	0.00
7.9950	0.09292	149803.	3091.	-0.00203	0.00	8.98E+09	-124.800	3143.	0.00
8.1900	0.08820	157162.	2803.	-0.00199	0.00	8.98E+09	-121.355	3220.	0.00
8.3850	0.08358	163847.	2523.	-0.00195	0.00	8.98E+09	-117.737	3296.	0.00
8.5800	0.07906	169878.	2252.	-0.00191	0.00	8.98E+09	-113.960	3373.	0.00
8.7750	0.07464	175275.	1990.	-0.00186	0.00	8.98E+09	-110.039	3450.	0.00
8.9700	0.07033	180058.	1737.	-0.00182	0.00	8.98E+09	-105.990	3526.	0.00
9.1650	0.06613	184250.	1494.	-0.00177	0.00	8.98E+09	-101.828	3603.	0.00
9.3600	0.06205	187873.	1261.	-0.00172	0.00	8.98E+09	-97.568	3680.	0.00
9.5550	0.05807	190951.	1037.	-0.00167	0.00	8.98E+09	-93.223	3756.	0.00
9.7500	0.05422	193507.	824.5024	-0.00162	0.00	8.98E+09	-88.810	3833.	0.00
9.9450	0.05048	195564.	621.9173	-0.00157	0.00	8.98E+09	-84.340	3910.	0.00
10.1400	0.04686	197148.	429.8391	-0.00152	0.00	8.98E+09	-79.829	3986.	0.00
10.3350	0.04336	198283.	248.3499	-0.00147	0.00	8.98E+09	-75.290	4063.	0.00
10.5300	0.03999	198994.	77.5007	-0.00142	0.00	8.98E+09	-70.735	4140.	0.00
10.7250	0.03673	199305.	-82.688	-0.00137	0.00	8.98E+09	-66.178	4216.	0.00
10.9200	0.03359	199242.	-232.223	-0.00131	0.00	8.98E+09	-61.630	4293.	0.00
11.1150	0.03058	198829.	-371.143	-0.00126	0.00	8.98E+09	-57.104	4370.	0.00
11.3100	0.02769	198092.	-499.511	-0.00121	0.00	8.98E+09	-52.611	4446.	0.00
11.5050	0.02492	197054.	-617.416	-0.00116	0.00	8.98E+09	-48.162	4523.	0.00
11.7000	0.02227	195741.	-724.975	-0.00111	0.00	8.98E+09	-43.768	4600.	0.00
11.8950	0.01974	194176.	-822.327	-0.00106	0.00	8.98E+09	-39.439	4676.	0.00
12.0900	0.01732	192384.	-909.637	-0.00101	0.00	8.98E+09	-35.184	4753.	0.00

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12.2850	0.01503	190387.	-987.088	-9.56E-04	0.00	8.98E+09	-31.014	4829.	0.00
12.4800	0.01285	188209.	-1055.	-9.07E-04	0.00	8.98E+09	-26.936	4906.	0.00
12.6750	0.01078	185872.	-1113.	-8.58E-04	0.00	8.98E+09	-22.960	4983.	0.00
12.8700	0.00883	183398.	-1162.	-8.10E-04	0.00	8.98E+09	-19.094	5059.	0.00
13.0650	0.00699	180808.	-2324.	-7.63E-04	0.00	8.98E+09	-973.658	325869.	0.00
13.2600	0.00526	172876.	-4337.	-7.16E-04	0.00	8.98E+09	-746.647	332007.	0.00
13.4550	0.00364	160846.	-5825.	-6.73E-04	0.00	8.98E+09	-525.468	337931.	0.00
13.6500	0.00211	145928.	-6803.	-6.33E-04	0.00	8.98E+09	-310.289	343639.	0.00
13.8450	6.76E-04	129302.	-7284.	-5.97E-04	0.00	8.98E+09	-100.896	349142.	0.00
14.0400	-6.82E-04	112116.	-7326.	-5.03E-04	0.00	1.70E+09	64.6828	222062.	0.00
14.2350	-0.00168	95249.	-7066.	-3.61E-04	0.00	1.71E+09	158.1226	220344.	0.00
14.4300	-0.00237	79216.	-6621.	-2.41E-04	0.00	1.71E+09	222.0982	219183.	0.00
14.6250	-0.00281	64375.	-6054.	-1.43E-04	0.00	1.71E+09	262.2488	218468.	0.00
14.8200	-0.00304	50949.	-5416.	-6.40E-05	0.00	1.71E+09	283.3850	218105.	0.00
15.0150	-0.00311	39059.	-4745.	-2.40E-06	0.00	1.71E+09	289.6193	218015.	0.00
15.2100	-0.00305	28742.	-4074.	4.40E-05	0.00	1.71E+09	284.4635	218131.	0.00
15.4050	-0.00290	19974.	-3424.	7.74E-05	0.00	1.71E+09	270.9014	218396.	0.00
15.6000	-0.00269	12682.	-2813.	9.97E-05	0.00	1.71E+09	251.4464	218765.	0.00
15.7950	-0.00244	6763.	-2252.	1.13E-04	0.00	1.71E+09	228.1883	219198.	0.00
15.9900	-0.00216	2092.	-1747.	1.19E-04	0.00	1.71E+09	202.8350	219665.	0.00
16.1850	-0.00188	-1469.	-1303.	1.19E-04	0.00	1.71E+09	176.7497	220140.	0.00
16.3800	-0.00160	-4062.	-919.746	1.16E-04	0.00	1.71E+09	150.9862	220606.	0.00
16.5750	-0.00134	-5828.	-595.289	1.09E-04	0.00	1.71E+09	126.3274	221049.	0.00
16.7700	-0.00109	-6899.	-326.602	1.00E-04	0.00	1.71E+09	103.3192	221459.	0.00
16.9650	-8.68E-04	-7403.	-109.422	9.04E-05	0.00	1.71E+09	82.3049	221831.	0.00
17.1600	-6.68E-04	-7453.	61.1214	8.03E-05	0.00	1.71E+09	63.4585	222163.	0.00
17.3550	-4.92E-04	-7154.	190.1420	7.03E-05	0.00	1.71E+09	46.8156	222454.	0.00
17.5500	-3.39E-04	-6596.	282.7112	6.09E-05	0.00	1.71E+09	32.3034	222707.	0.00
17.7450	-2.07E-04	-5859.	343.6335	5.24E-05	0.00	1.71E+09	19.7670	222923.	0.00
17.9400	-9.43E-05	-5012.	377.2831	4.49E-05	0.00	1.71E+09	8.9934	223108.	0.00
18.1350	2.80E-06	-4114.	387.4928	3.87E-05	0.00	1.71E+09	-0.267	223257.	0.00
18.3300	8.68E-05	-3217.	377.5015	3.37E-05	0.00	1.71E+09	-8.272	223121.	0.00
18.5250	1.60E-04	-2363.	349.9355	2.99E-05	0.00	1.71E+09	-15.288	223004.	0.00
18.7200	2.27E-04	-1593.	306.8018	2.72E-05	0.00	1.71E+09	-21.578	222899.	0.00
18.9150	2.88E-04	-940.153	249.5232	2.54E-05	0.00	1.71E+09	-27.378	222803.	0.00
19.1100	3.46E-04	-436.988	179.0125	2.45E-05	0.00	1.71E+09	-32.888	222713.	0.00
19.3050	4.02E-04	-113.763	95.7697	2.41E-05	0.00	1.71E+09	-38.260	222626.	0.00
19.5000	4.58E-04	0.00	0.00	2.40E-05	0.00	1.71E+09	-43.594	111270.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.26259055 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -635773. inch-lbs
 Maximum shear force = 10600. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 8
 Number of zero deflection points = 2

Pile-head Deflection vs. Pile Length for Load Case 2

Boundary Condition Type 2, Shear and Slope

Shear = 10600. lbs
 Slope = 0.00000
 Axial Load = 99370. lbs

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Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
19.50000	0.26259055	-635773.	10600.
18.52500	0.26338379	-635491.	10600.
17.55000	0.26391106	-635708.	10600.
16.57500	0.26272501	-635569.	10600.
15.60000	0.26628091	-636319.	10600.
14.62500	0.28008474	-642225.	10600.
13.65000	0.30090914	-654837.	10600.
12.67500	0.34111722	-736838.	10600.
11.70000	0.34885929	-762715.	10600.
10.72500	0.35032581	-778243.	10600.
9.75000	0.34875915	-775995.	10600.
8.77500	0.35548178	-751383.	10600.
7.80000	0.40461267	-695853.	10600.

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
 Displacement of pile head = 1.000000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 99370.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-1940992.	27994.	0.00	0.00	7.96E+09	0.00	0.00	0.00
0.1950	0.9993	-1875435.	27982.	-5.61E-04	0.00	7.96E+09	-4.845	11.3449	0.00
0.3900	0.9974	-1809776.	27964.	-0.00110	0.00	7.98E+09	-10.372	24.3349	0.00
0.5850	0.9942	-1744051.	27933.	-0.00162	0.00	7.99E+09	-16.316	38.4033	0.00
0.7800	0.9898	-1678296.	27888.	-0.00212	0.00	8.00E+09	-22.429	53.0260	0.00
0.9750	0.9842	-1612550.	27828.	-0.00260	0.00	8.02E+09	-28.535	67.8415	0.00
1.1700	0.9776	-1546850.	27754.	-0.00306	0.00	8.03E+09	-34.473	82.5154	0.00
1.3650	0.9699	-1481235.	27667.	-0.00351	0.00	8.05E+09	-40.043	96.6083	0.00
1.5600	0.9612	-1415739.	27567.	-0.00393	0.00	8.06E+09	-45.744	111.3639	0.00
1.7550	0.9515	-1350397.	27454.	-0.00433	0.00	8.08E+09	-50.905	125.1875	0.00
1.9500	0.9409	-1285244.	27329.	-0.00471	0.00	8.10E+09	-55.772	138.6987	0.00
2.1450	0.9295	-1220309.	27193.	-0.00507	0.00	8.11E+09	-59.998	151.0460	0.00
2.3400	0.9172	-1155621.	27048.	-0.00541	0.00	8.13E+09	-64.307	164.0626	0.00
2.5350	0.9041	-1091208.	26892.	-0.00574	0.00	8.16E+09	-68.890	178.2915	0.00
2.7300	0.8904	-1027099.	26725.	-0.00604	0.00	8.18E+09	-73.443	193.0181	0.00
2.9250	0.8759	-963324.	26546.	-0.00632	0.00	8.21E+09	-79.813	213.2257	0.00
3.1200	0.8608	-899923.	26352.	-0.00659	0.00	8.24E+09	-86.060	233.9545	0.00
3.3150	0.8451	-836933.	26144.	-0.00683	0.00	8.27E+09	-92.135	255.1253	0.00
3.5100	0.8288	-774392.	25921.	-0.00706	0.00	8.31E+09	-97.985	276.6499	0.00
3.7050	0.8120	-712338.	25683.	-0.00727	0.00	8.35E+09	-105.801	304.8916	0.00
3.9000	0.7948	-650816.	25424.	-0.00746	0.00	8.40E+09	-115.191	339.1551	0.00
4.0950	0.7771	-589883.	25143.	-0.00763	0.00	8.45E+09	-124.919	376.1596	0.00
4.2900	0.7590	-529596.	24839.	-0.00779	0.00	8.52E+09	-134.977	416.1160	0.00
4.4850	0.7406	-470014.	24511.	-0.00792	0.00	8.59E+09	-145.383	459.3239	0.00
4.6800	0.7219	-411198.	24158.	-0.00804	0.00	8.68E+09	-156.862	508.4250	0.00
4.8750	0.7030	-353216.	23777.	-0.00815	0.00	8.79E+09	-168.772	561.7740	0.00
5.0700	0.6838	-296136.	23367.	-0.00823	0.00	8.98E+09	-181.111	619.7452	0.00
5.2650	0.6645	-240030.	22928.	-0.00830	0.00	8.98E+09	-193.880	682.7592	0.00
5.4600	0.6450	-184971.	22459.	-0.00836	0.00	8.98E+09	-207.080	751.2828	0.00
5.6550	0.6254	-131035.	21959.	-0.00840	0.00	8.98E+09	-220.709	825.8352	0.00
5.8500	0.6057	-78299.	21426.	-0.00842	0.00	8.98E+09	-234.768	906.9943	0.00
6.0450	0.5860	-26844.	20860.	-0.00844	0.00	8.98E+09	-249.257	995.4047	0.00
6.2400	0.5662	23247.	20259.	-0.00844	0.00	8.98E+09	-264.175	1092.	0.00
6.4350	0.5465	71891.	19623.	-0.00843	0.00	8.98E+09	-279.524	1197.	0.00

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6.6300	0.5268	119000.	18950.	-0.00840	0.00	8.98E+09	-295.303	1312.	0.00
6.8250	0.5071	164485.	18240.	-0.00836	0.00	8.98E+09	-311.512	1437.	0.00
7.0200	0.4876	208254.	17492.	-0.00832	0.00	8.98E+09	-328.150	1575.	0.00
7.2150	0.4682	250214.	16704.	-0.00826	0.00	8.98E+09	-345.219	1725.	0.00
7.4100	0.4490	290268.	15876.	-0.00819	0.00	8.98E+09	-362.717	1890.	0.00
7.6050	0.4299	328318.	15006.	-0.00810	0.00	8.97E+09	-380.645	2072.	0.00
7.8000	0.4111	364264.	14094.	-0.00801	0.00	8.97E+09	-399.004	2271.	0.00
7.9950	0.3924	398004.	13148.	-0.00791	0.00	8.70E+09	-409.161	2440.	0.00
8.1900	0.3740	429478.	12187.	-0.00780	0.00	8.65E+09	-412.486	2581.	0.00
8.3850	0.3559	458666.	11219.	-0.00768	0.00	8.61E+09	-415.077	2729.	0.00
8.5800	0.3381	485553.	10245.	-0.00755	0.00	8.57E+09	-416.940	2886.	0.00
8.7750	0.3206	510126.	9268.	-0.00742	0.00	8.54E+09	-418.081	3052.	0.00
8.9700	0.3034	532377.	8289.	-0.00727	0.00	8.51E+09	-418.510	3228.	0.00
9.1650	0.2865	552303.	7310.	-0.00712	0.00	8.49E+09	-418.241	3416.	0.00
9.3600	0.2700	569903.	6333.	-0.00697	0.00	8.47E+09	-417.288	3616.	0.00
9.5550	0.2539	585181.	5368.	-0.00681	0.00	8.46E+09	-407.587	3756.	0.00
9.7500	0.2382	598190.	4434.	-0.00665	0.00	8.45E+09	-390.115	3833.	0.00
9.9450	0.2228	609025.	3542.	-0.00648	0.00	8.44E+09	-372.260	3910.	0.00
10.1400	0.2078	617782.	2693.	-0.00631	0.00	8.43E+09	-354.072	3986.	0.00
10.3350	0.1933	624560.	1886.	-0.00614	0.00	8.42E+09	-335.601	4063.	0.00
10.5300	0.1791	629460.	1122.	-0.00596	0.00	8.42E+09	-316.894	4140.	0.00
10.7250	0.1654	632584.	402.8459	-0.00579	0.00	8.41E+09	-297.997	4216.	0.00
10.9200	0.1521	634036.	-272.189	-0.00561	0.00	8.41E+09	-278.955	4293.	0.00
11.1150	0.1391	633919.	-902.545	-0.00543	0.00	8.41E+09	-259.811	4370.	0.00
11.3100	0.1266	632339.	-1488.	-0.00526	0.00	8.41E+09	-240.604	4446.	0.00
11.5050	0.1145	629400.	-2029.	-0.00508	0.00	8.42E+09	-221.372	4523.	0.00
11.7000	0.1028	625208.	-2524.	-0.00491	0.00	8.42E+09	-202.153	4600.	0.00
11.8950	0.09157	619870.	-2975.	-0.00473	0.00	8.43E+09	-182.981	4676.	0.00
12.0900	0.08069	613489.	-3381.	-0.00456	0.00	8.43E+09	-163.888	4753.	0.00
12.2850	0.07021	606171.	-3742.	-0.00439	0.00	8.44E+09	-144.905	4829.	0.00
12.4800	0.06012	598021.	-4059.	-0.00423	0.00	8.45E+09	-126.059	4906.	0.00
12.6750	0.05043	589141.	-4332.	-0.00406	0.00	8.45E+09	-107.379	4983.	0.00
12.8700	0.04111	579636.	-4562.	-0.00390	0.00	8.46E+09	-88.888	5059.	0.00
13.0650	0.03217	569607.	-8808.	-0.00374	0.00	8.47E+09	-3541.	257560.	0.00
13.2600	0.02360	549153.	-16227.	-0.00359	0.00	8.51E+09	-2800.	277644.	0.00
13.4550	0.01537	495334.	-21808.	-0.00345	0.00	8.56E+09	-1970.	299867.	0.00
13.6500	0.00746	439697.	-25324.	-0.00332	0.00	8.63E+09	-1035.	324613.	0.00
13.8450	-1.66E-04	378363.	-26506.	-0.00321	0.00	8.73E+09	24.8894	351148.	0.00
14.0400	-0.00756	317142.	-25681.	-0.00229	0.00	4.29E+08	680.4224	210663.	0.00
14.2350	-0.01090	259244.	-23764.	-0.00102	0.00	7.44E+08	957.7971	205595.	0.00
14.4300	-0.01234	206401.	-21388.	-3.91E-04	0.00	1.08E+09	1073.	203552.	0.00
14.6250	-0.01273	159331.	-18839.	-4.03E-05	0.00	1.45E+09	1105.	203062.	0.00
14.8200	-0.01253	118252.	-16272.	1.69E-04	0.00	1.70E+09	1089.	203440.	0.00
15.0150	-0.01194	83098.	-13778.	3.07E-04	0.00	1.71E+09	1043.	204365.	0.00
15.2100	-0.01109	53627.	-11418.	4.01E-04	0.00	1.71E+09	974.6567	205678.	0.00
15.4050	-0.01006	29477.	-9234.	4.58E-04	0.00	1.71E+09	891.4048	207249.	0.00
15.6000	-0.00895	10198.	-7257.	4.85E-04	0.00	1.71E+09	798.9294	208971.	0.00
15.7950	-0.00780	-4710.	-5500.	4.89E-04	0.00	1.71E+09	702.0771	210757.	0.00
15.9900	-0.00666	-15772.	-3971.	4.75E-04	0.00	1.71E+09	604.8148	212534.	0.00
16.1850	-0.00557	-23517.	-2667.	4.48E-04	0.00	1.71E+09	510.3009	214248.	0.00
16.3800	-0.00456	-28460.	-1577.	4.12E-04	0.00	1.71E+09	420.9436	215856.	0.00
16.5750	-0.00364	-31090.	-688.654	3.71E-04	0.00	1.71E+09	338.4608	217331.	0.00
16.7700	-0.00282	-31856.	16.1657	3.28E-04	0.00	1.71E+09	263.9490	218655.	0.00
16.9650	-0.00211	-31167.	556.5989	2.85E-04	0.00	1.71E+09	197.9597	219820.	0.00
17.1600	-0.00149	-29384.	952.6940	2.44E-04	0.00	1.71E+09	140.5831	220827.	0.00
17.3550	-9.66E-04	-26821.	1224.	2.05E-04	0.00	1.71E+09	91.5351	221682.	0.00
17.5500	-5.29E-04	-23750.	1390.	1.71E-04	0.00	1.71E+09	50.2427	222398.	0.00
17.7450	-1.67E-04	-20395.	1468.	1.41E-04	0.00	1.71E+09	15.9263	222988.	0.00
17.9400	1.29E-04	-16947.	1472.	1.15E-04	0.00	1.71E+09	-12.303	223052.	0.00
18.1350	3.71E-04	-13560.	1416.	9.41E-05	0.00	1.71E+09	-35.301	222662.	0.00
18.3300	5.69E-04	-10363.	1311.	7.77E-05	0.00	1.71E+09	-54.113	222346.	0.00
18.5250	7.35E-04	-7459.	1167.	6.55E-05	0.00	1.71E+09	-69.739	222086.	0.00
18.7200	8.76E-04	-4934.	987.7923	5.71E-05	0.00	1.71E+09	-83.081	221866.	0.00
18.9150	0.00100	-2862.	779.5408	5.17E-05	0.00	1.71E+09	-94.912	221673.	0.00
19.1100	0.00112	-1310.	544.6348	4.89E-05	0.00	1.71E+09	-105.863	221496.	0.00
19.3050	0.00123	-336.180	284.5828	4.78E-05	0.00	1.71E+09	-116.404	221327.	0.00
19.5000	0.00134	0.00	0.00	4.75E-05	0.00	1.71E+09	-126.829	110580.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-

tionships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -1940992. inch-lbs
 Maximum shear force = 27994. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 0.000000 feet below pile head
 Number of iterations = 17
 Number of zero deflection points = 2

 Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	20290.	S, rad	0.00	137970.	0.5973	0.00	20290.	-1310512.
2	V, lb	10600.	S, rad	0.00	99370.	0.2626	0.00	10600.	-635773.
3	y, in	1.0000	S, rad	0.00	99370.	1.0000	0.00	27994.	-1940992.

Maximum pile-head deflection = 1.000000000 inches
 Maximum pile-head rotation = -0.000000000 radians = -0.000000 deg.

The analysis ended normally.

APPENDIX 3

Seismic Design Maps

(7 Sheets)

LAMSON ENGINEERING CORPORATION		Final Page No.: 1	
Project: Br. No. W-38-003, Wilmington, MA	Job No.:	Preliminary Sheet No.:	
Subject: Seismic Calculations	Prepared by: SL	Date: 05/2021	
Detail: N1 Blow Counts & Seismic Design Coefficients	Checked by: WD	Date: 05/2021	

BB-2B

Depth ft	N blows/ft	d_i ft	d_i/N_i ft ² /blow	
		0.0		Ground Surface Elev. 101.5
5.00	19	5.0	0.26	
11.00	11	6.0	0.55	
16.00	97	5.0	0.05	
20.67	100	4.7	0.05	
26.00	37	5.3	0.14	
30.63	100	4.6	0.05	
100.00	100	69.4	0.69	Assume $N = 100$ for bedrock
Sum		100	1.79	

$$15 < \bar{N} = \underline{\quad 56 \quad} > 50$$

Due to shallow bedrock

The site class is considered as Site Class C per Table 3.4.2.1-1 of AASHTO Guide Specifications.

From Appendix 3:

$$\begin{aligned}
 PGA &= 0.08 \text{ g} \\
 S_s &= 0.16 \text{ g} \\
 S_1 &= 0.04 \text{ g}
 \end{aligned}$$

LAMSON ENGINEERING CORPORATION		Final Page No.: 2	
Project: Br. No. W-38-003, Wilmington, MA	Job No.:		Preliminary Sheet No.:
Subject: Seismic Calculations	Prepared by: SL		Date: 05/2021
Detail: N1 Blow Counts & Seismic Design Coefficients	Checked by: WD		Date: 05/2021

Per Tables 3.4.2.3-1 & 3.4.2.3-2 of AASHTO Guide Specifications

$$\begin{aligned}
 F_{pga} &= 1.2 \\
 F_a &= 1.2 \\
 F_v &= 1.7
 \end{aligned}$$

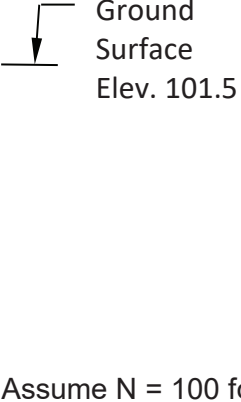
Therefore,

$$\begin{aligned}
 A_s &= 0.096 \text{ g} \\
 S_{DS} &= 0.192 \text{ g} \\
 S_{D1} &= 0.068 \text{ g} < 0.15\text{g}
 \end{aligned}$$

$$\text{Seismic Design Category (SDC)} = \underline{\hspace{10em} A \hspace{10em}}$$

LAMSON ENGINEERING CORPORATION		Final Page No.: 3	
Project: Br. No. W-38-003, Wilmington, MA	Job No.:		Preliminary Sheet No.:
Subject: Seismic Calculations	Prepared by: SL		Date: 05/2021
Detail: N1 Blow Counts & Seismic Design Coefficients	Checked by: WD		Date: 05/2021

BB-1

Depth ft	N blows/ft	d_i ft	d_i/N_i ft ² /blow	
2.00	42	2.0	0.05	
5.00	22	3.0	0.14	
9.08	100	4.1	0.04	
16.50	16	7.4	0.46	
20.00	30	3.5	0.12	
25.00	22	5.0	0.23	
31.00	24	6.0	0.25	
100.00	100	69.0	0.69	
Sum		100	1.97	

$$15 < \bar{N} = \underline{\quad 51 \quad} > 50$$

Due to shallow bedrock

The site class is considered as Site Class C per Table 3.4.2.1-1 of AASHTO Guide Specifications.

From Appendix 3:

$$\begin{aligned}
 \text{PGA} &= 0.072 \text{ g} \\
 S_s &= 0.15 \text{ g} \\
 S_1 &= 0.04 \text{ g}
 \end{aligned}$$

LAMSON ENGINEERING CORPORATION		Final Page No.: 4	
Project: Br. No. W-38-003, Wilmington, MA	Job No.:		Preliminary Sheet No.:
Subject: Seismic Calculations	Prepared by: SL		Date: 05/2021
Detail: N1 Blow Counts & Seismic Design Coefficients	Checked by: WD		Date: 05/2021

Per Tables 3.4.2.3-1 & 3.4.2.3-2 of AASHTO Guide Specifications

$$\begin{aligned}
 F_{pga} &= 1.2 \\
 F_a &= 1.2 \\
 F_v &= 1.7
 \end{aligned}$$

Therefore,

$$\begin{aligned}
 A_s &= 0.086 \text{ g} \\
 S_{DS} &= 0.180 \text{ g} \\
 S_{D1} &= 0.068 \text{ g} < 0.15\text{g}
 \end{aligned}$$

$$\text{Seismic Design Category (SDC)} = \underline{\hspace{10em} A \hspace{10em}}$$

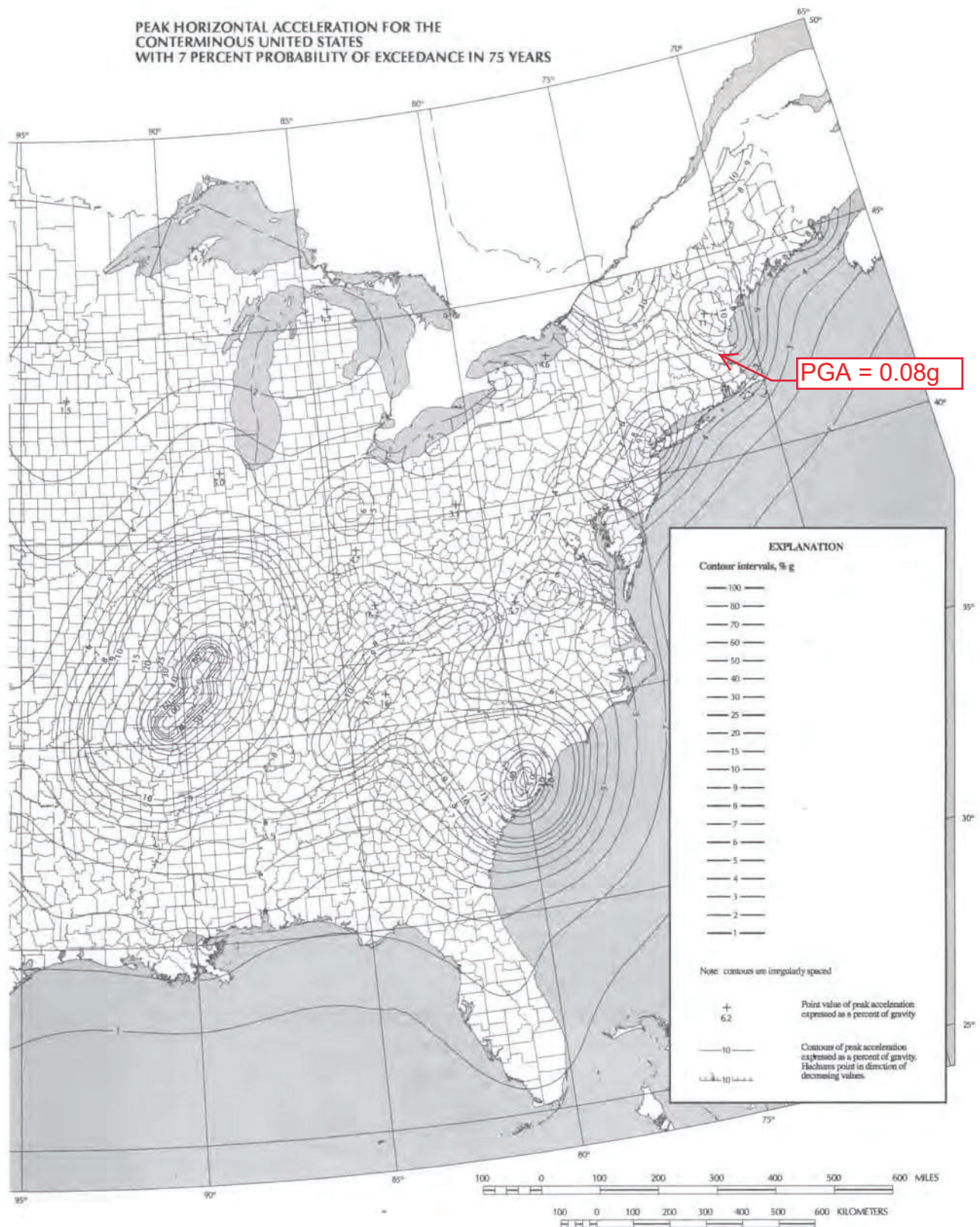


Figure 3.4.1-2b—Horizontal Peak Ground Acceleration Coefficient for the Conterminous United States (*PGA*) with Seven Percent Probability of Exceedance in 75 yr (Approx. 1000-yr Return Period)

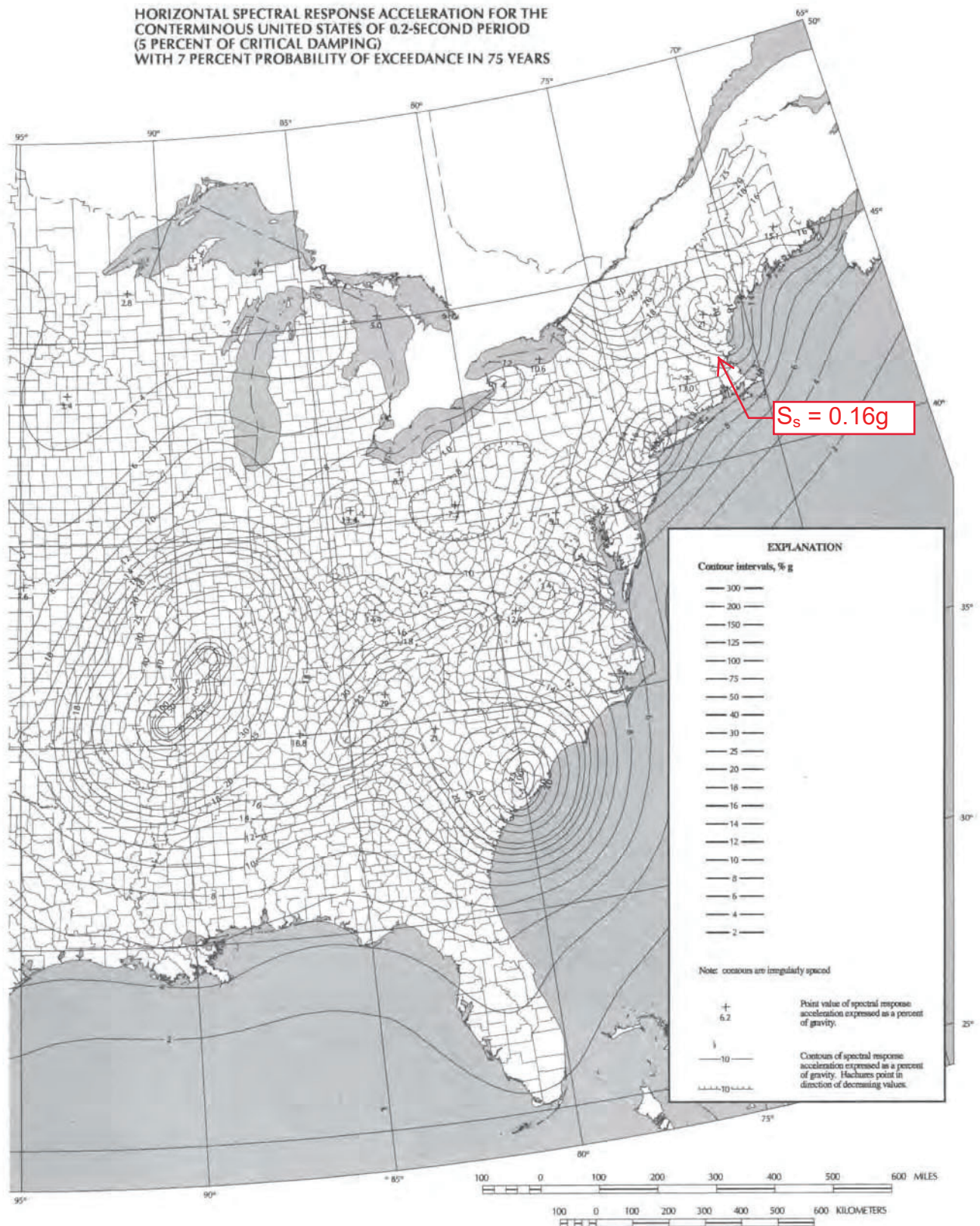


Figure 3.4.1-3b—Horizontal Response Spectral Acceleration Coefficient for the Conterminous United States at Period of 0.2-sec (S_s) with Seven Percent Probability of Exceedance in 75 yr (Approx. 1000-yr Return Period) and Five Percent Critical Damping

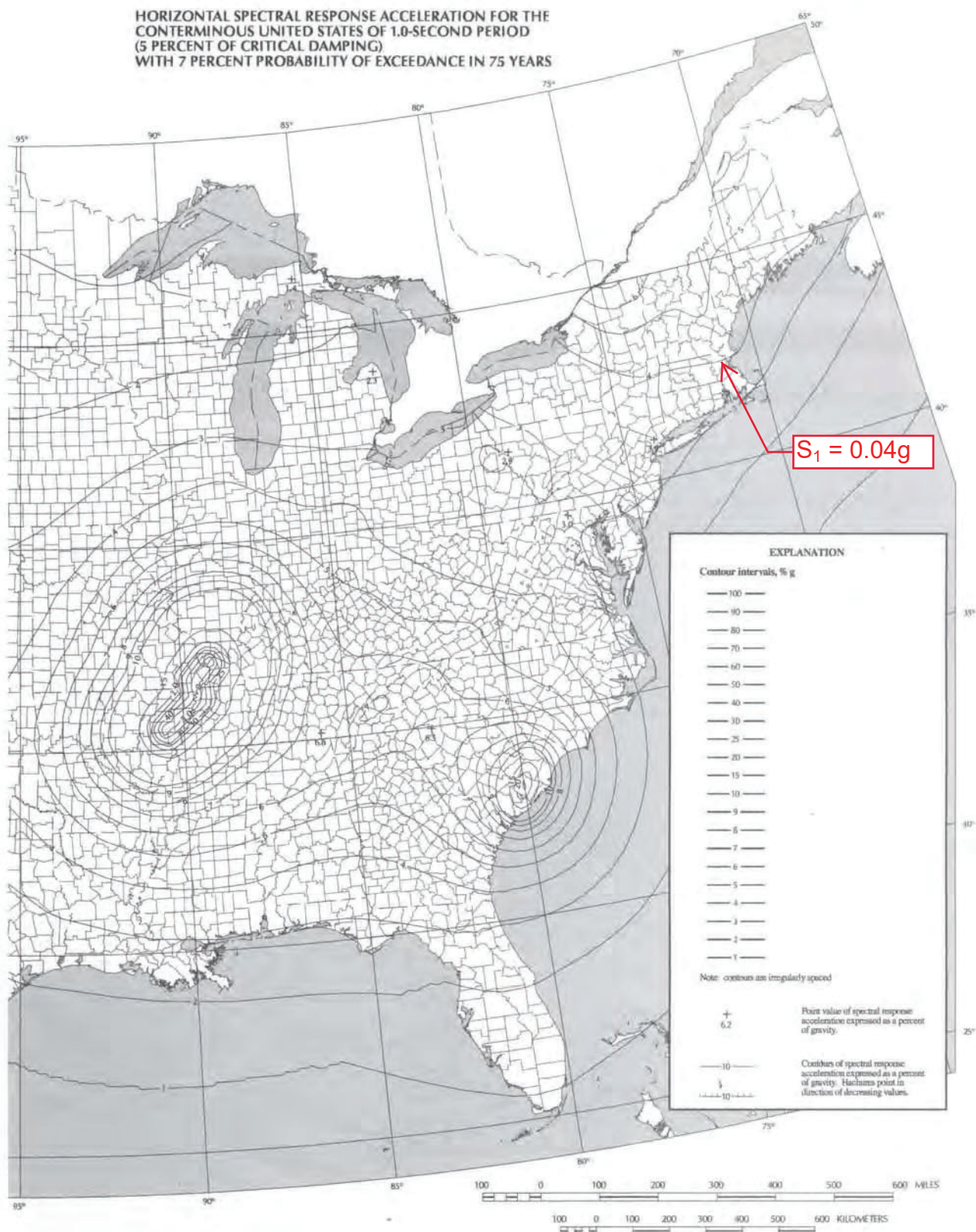


Figure 3.4.1-4b—Horizontal Response Spectral Acceleration Coefficient for the Conterminous United States at Period of 1.0-sec (S_1) with Seven Percent Probability of Exceedance in 75 yr (Approx. 1000-yr Return Period) and Five Percent Critical Damping

APPENDIX 4

Loads from Green International Affiliates, Inc.

(7 Sheets)



GREEN INTERNATIONAL AFFILIATES, INC.
100 AMES POND DRIVE, SUITE 200 TEWKSBURY, MA 01876
T: (978) 923-0400 | WWW.GREENINTL.COM

JOB NO. 13033.18X
JOB NAME: Wilmington - Butters Row
CALCULATED BY: HD DATE 04/22
DESCRIPTION: Bridge W-38-003 Design Calculation

SHEET NO.: 1 OF 50

CHECKED BY: KG DATE 6/1/2020

1.0 SUBSTRUCTURE LOADS (CONT'D)

1.20 Load Factors

Table 1.9 Load Combinations and Load Factors										
LOAD	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
	γ_{\max}	γ_{\min}	γ_{\max}	γ_{\min}	γ_{\max}	γ_{\min}	γ_{\max}	γ_{\min}	γ_{\max}	γ_{\min}
DC	1.25	0.90	1.25	0.90	1.25	0.90	1.00	1.00	1.00	1.00
DW	1.50	0.65	1.50	0.65	1.50	0.65	1.00	1.00	1.00	1.00
LL	1.75	1.75	0.00	0.00	1.35	1.35	1.00	1.00	0.00	0.00
IM	1.75	1.75	0.00	0.00	1.35	1.35	1.00	1.00	0.00	0.00
PL	1.75	1.75	0.00	0.00	1.35	1.35	1.00	1.00	0.00	0.00
EH	1.50	0.90	1.50	0.90	1.50	0.90	1.00	1.00	1.00	1.00
EV	1.35	1.00	1.35	1.00	1.35	1.00	1.00	1.00	1.00	1.00
BR	1.75	1.75	0.00	0.00	1.35	1.35	1.00	1.00	0.00	0.00
WS	0.00	0.00	1.40	1.40	0.40	0.40	0.30	0.30	0.00	0.00
WL	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00
TU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
EQ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00



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SHEET NO.: 1 OF 50

CHECKED BY: KG
DATE 6/1/2020

1.0 SUBSTRUCTURE LOADS (CONT'D)

1.21 Summary of Factored Load at Abutment

Table 1.10 Factored Vertical Load										
LOAD	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
DC (super)	212.4	152.9	212.4	152.9	212.4	152.9	169.9	169.9	169.9	169.9
DC (app)	25.0	18.0	25.0	18.0	25.0	18.0	20.0	20.0	20.0	20.0
DC (stem)	932.6	671.5	932.6	671.5	932.6	671.5	746.1	746.1	746.1	746.1
DC (footing)	511.6	368.4	511.6	368.4	511.6	368.4	409.3	409.3	409.3	409.3
DC (heel)	1420.0	1022.4	1420.0	1022.4	1420.0	1022.4	1136.0	1136.0	1136.0	1136.0
DC (toe)	54.6	39.3	54.6	39.3	54.6	39.3	43.7	43.7	43.7	43.7
DW	32.6	23.5	32.6	23.5	32.6	23.5	26.1	26.1	26.1	26.1
LL	238.6	238.6	0.0	0.0	184.1	184.1	136.4	136.4	0.0	0.0
IM	63.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRV	6.9	6.9	0.0	0.0	5.3	5.3	3.9	3.9	0.0	0.0
WLV	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0
TOTAL	3499.0	2542.0	3189.0	2296.0	3379.0	2486.0	2692.0	2692.0	2552.0	2552.0



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DESCRIPTION: Bridge W-38-003 Design Calculation

1.0 SUBSTRUCTURE LOADS (CONT'D)

1.21 Summary of Factored Load at Abutment (Cont'd)

Table 1.1.11 Factored Horizontal Load in the X-Direction (Parrallel to Abutment)										
LOAD	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
BR	6.2	6.2	0.0	0.0	4.8	4.8	3.5	3.5	0.0	0.0
WS (super)	0.0	0.0	3.4	3.4	1.0	1.0	0.7	0.7	0.0	0.0
WS (sub)	0.0	0.0	1.9	1.9	0.5	0.5	0.4	0.4	0.0	0.0
WL	0.0	0.0	0.0	0.0	2.1	2.1	2.1	2.1	0.0	0.0
TU	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0
EQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	21.3
EH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	9.0	9.0	8.0	8.0	11.0	11.0	10.0	10.0	22.0	22.0



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1.0 SUBSTRUCTURE LOADS (CONT'D)

1.21 Summary of Factored Load at Abutment (Cont'd)

Table 1.12 Factored Horizontal Load in the Y-Direction (Perpendicular to Abutment)										
LOAD	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
BR	30.9	30.9	0.0	0.0	23.8	23.8	17.6	17.6	0.0	0.0
WS (super)	0.0	0.0	1.5	1.5	0.4	0.4	0.3	0.3	0.0	0.0
WS (sub)	0.0	0.0	5.4	5.4	1.6	1.6	1.2	1.2	0.0	0.0
WL	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	0.0	0.0
TU	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	0.0	0.0
EQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	21.3
EH	1633.2	979.9	1633.2	979.9	1633.2	979.9	1088.8	1088.8	1088.8	1088.8
TOTAL	1677.0	1024.0	1653.0	1000.0	1673.0	1020.0	1122.0	1122.0	1111.0	1111.0

Proposal No. 608929 - 123406



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1.0 SUBSTRUCTURE LOADS (CONT'D)

1.2.1 Summary of Factored Load at Abutment (Cont'd)

Table 1.13 Factored Moment at Bottom of Footing due to Vertical Load

LOAD	Moment Arm (ft)	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
		MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
DC (super)	2.75	584.0	420.5	584.0	420.5	584.0	420.5	467.2	467.2	467.2	467.2
DC (app)	-5.00	-125.0	-90.0	-125.0	-90.0	-125.0	-90.0	-100.0	-100.0	-100.0	-100.0
DC (stem)	2.05	1911.9	1376.6	1911.9	1376.6	1911.9	1376.6	1529.5	1529.5	1529.5	1529.5
DC (footing)	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC (heel)	-4.00	-5680.0	-4089.6	-5680.0	-4089.6	-5680.0	-4089.6	-4544.0	-4544.0	-4544.0	-4544.0
DC (toe)	6.04	329.7	237.4	329.7	237.4	329.7	237.4	263.7	263.7	263.7	263.7
DW	2.75	89.7	64.6	89.7	64.6	89.7	64.6	71.7	71.7	71.7	71.7
LL	2.75	656.3	656.3	0.0	0.0	506.3	506.3	375.0	375.0	0.0	0.0
IM	2.75	175.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRV	2.75	19.0	19.0	0.0	0.0	14.7	14.7	10.9	10.9	0.0	0.0
WLV	2.75	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.0	0.0
TOTAL		-2039.0	-1406.0	-2890.0	-2081.0	-2369.0	-1559.0	-1926.0	-1926.0	-2312.0	-2312.0



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1.0 SUBSTRUCTURE LOADS (CONT'D)

1.21 Summary of Factored Load at Abutment (Cont'd)

Table 1.14 Factored Moment at Bottom of Footing about the Y-Axis due to Parallel Horizontal Load

LOAD	Moment Arm (ft)	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
		MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
BR	27.27	168.8	168.8	0.0	0.0	130.3	130.3	96.5	96.5	0.0	0.0
WS (super)	27.27	0.0	0.0	93.6	93.6	26.8	26.8	20.1	20.1	0.0	0.0
WS (sub)	13.67	0.0	0.0	26.1	26.1	7.5	7.5	5.6	5.6	0.0	0.0
WL	27.27	0.0	0.0	0.0	0.0	58.1	58.1	58.1	58.1	0.0	0.0
TU	27.27	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	0.0	0.0
EQ	27.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	581.5	581.5
EH	10.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	TOTAL	239.0	239.0	190.0	190.0	292.0	292.0	250.0	250.0	582.0	582.0



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DATE 6/1/2020

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1.0 SUBSTRUCTURE LOADS (CONT'D)

1.21 Summary of Factored Load at Abutment (Cont'd)

Table 1.15 Factored Moment at Bottom of Footing about the Z-Axis due to Perpendicular Horizontal Load

LOAD	Moment Arm (ft)	STRENGTH 1		STRENGTH III		STRENGTH V		SERVICE I		EXTREME I	
		MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
BR	27.27	842.4	842.4	0.0	0.0	649.8	649.8	481.4	481.4	0.0	0.0
WS (super)	27.27	0.0	0.0	40.2	40.2	11.5	11.5	8.6	8.6	0.0	0.0
WS (sub)	13.67	0.0	0.0	74.3	74.3	21.2	21.2	15.9	15.9	0.0	0.0
WL	27.27	0.0	0.0	0.0	0.0	32.3	32.3	32.3	32.3	0.0	0.0
TU	27.27	346.0	346.0	346.0	346.0	346.0	346.0	346.0	346.0	0.0	0.0
EQ	27.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	581.5	581.5
EH	10.24	16715.8	10029.5	16715.8	10029.5	16715.8	10029.5	11143.9	11143.9	11143.9	11143.9
TOTAL	TOTAL	17905.0	11218.0	17177.0	10490.0	17777.0	11091.0	12029.0	12029.0	11726.0	11726.0

1.22 Summary of Maximum Factored Load at Bottom of Abutment Footing

Table 1.16 Summary of Maximum Factored Load at Bottom of Abutment Footing

LOAD	STRENGTH 1	STRENGTH III	STRENGTH V	SERVICE I	EXTREME I
VERTICAL	3499.0	3189.0	3379.0	2692.0	2552.0
HORIZONTAL X	9.0	8.0	11.0	10.0	22.0
HORIZONTAL Z	1677.0	1653.0	1673.0	1122.0	1111.0
MOMENT Z-Z	239.0	190.0	292.0	250.0	582.0
MOMENT X-X	17491.6	15912.7	17034.3	10103.8	9414.2

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